

# **Model DC-295**

## **SMD Disk Controller**

### **Technical Manual**

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## NOTICE

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If installation problems arise after you thoroughly review the manual, please contact the ZETACO Customer Support Hotline at (612) 941-9480.

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REVISION HISTORY

ECO No.	Date	Description	Pages
0103	3/10/83	Major Revision	
0162	8/8/83	Typo's	
0175	8/16/83	Per ECO	3-8
0185	9/12/83	Per ECO	3-8,3-9
0276	3/20/84	Changed Addendum (MDS)	
0328	6/28/84	New ZETACO Cover	
0523	3/4/86	New Cover	



## CUSTOMER SERVICE

Our warranty attests the quality of materials and workmanship in our products. If malfunction does occur, our service personnel will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions and technical advise is required, please phone ZETACO giving the serial number, board name, model number and problem description. You will be placed in contact with the appropriate technical assistance.

## PRODUCT RETURN

### Pre-return Checkout.

If controller malfunction is suspected, the use of test software is needed to determine if the controller is the problem and what in particular is wrong with the controller. The tests applicable to this board are listed on the next page of the manual. Please run the test sequence BEFORE considering product return.

### Returned Material Authorization.

Before returning a product to ZETACO, Inc. for repair, please ask for a "Returned Material Authorization" number. Each product returned requires a separate RMA number. Use of this number in correspondence and on a tag attached to the product will ensure proper handling and avoid unnecessary delays.

### Returned Material Information.

Information concerning the problem description, system configuration, diagnostic program name, revision level and results, i.e., error program counter number should be included with the returning material. A form is provided for this information on the next page of the manual.

### Packaging.

To safeguard your materials during shipment, please use packaging that is adequate to protect it from damage. Mark the box "Delicate Instrument" and indicate the RMA number(s) on the shipping label.



MATERIAL RETURN INFORMATION

All possible effort to test a suspected malfunctioning controller should be made before returning the controller to ZETACO, Inc. for repair. This will: 1) Determine if in fact the board is defective (many boards returned for repair are not defective, causing the user unnecessary system down-time, paper work, and handling while proper testing would indicate the board is working properly). 2) Increase the speed and accuracy of a product's repair which is often dependent upon a complete understanding of the user checkout test results, problem characteristics, and the user system configuration. Checkout results for the 295 SMD Controller should be obtained by performing the following tests. (Include error program counter numbers and accumulator contents if applicable).

FUNCTION	TEST	RESULT
SMD	Selftest	_____
	Diagnostics	_____
	Reliability	_____

Other test performed:

Please allow our service department to do the best job possible by answering the following questions thoroughly and returning this sheet with the malfunctioning board.

1. Does the problem appear to be intermittent or heat sensitive? (If yes, explain).
2. What operating system are you running under? (AOS RDOS, DDOS, DTOS).
3. Describe the system configuration (i.e. peripherals, I/O controllers, model of computer, etc.)
4. Has the controller been returned before? Same problem?

To be filled out by CUSTOMER:

Model #: \_\_\_\_\_  
Serial #: \_\_\_\_\_  
RMA #: \_\_\_\_\_

Returned by: \_\_\_\_\_  
(company name)





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## 1.0 INTRODUCTION

The ZETACO, Inc. 295 Storage Module Disk Controller provides a full emulation integration of Data General Nova/Eclipse Minicomputers, SMD Interface Disk Drives and RDOS/AOS/MPOS Operating Systems. It is fully compatible with Data General and Data General emulating minicomputers.

### Advantages:

- .Cost Savings to 60%
- .Faster Systems throughput
- .Increased Reliability
- .Increased Capacity
- .Hardware or Software Correctable ECC
- .Full Two Year Warranty

## 1.1 FEATURES

- .Emulation of Data General 6060, 6061, 6067 Disk Subsystem
- .Simultaneous Control of up to (4) SMD Interfaced Disk Drives
- .Incorporates an Eleven Bit SMD Tag Bus to accommodate full capacity of the larger Drives
- .Mix Drives of differing capacities and transfer rates
- .On-Board 32 bit error checking and correcting of burst errors up to 11 bits in length
- .High speed Microprocessor design supports maximum transfer rates
- .On-Board Self-test with error reporting and LED display
- .Capable of Three Sector Buffering
- .Sector Interleaving
- .Switch Selectable DMA Throttle Control
- .Support Overlap Seeks

- .Offset Positioning for Data Error Recovery
- .Data Strobe Early/Late for Data Error Recovery
- .Two Methods of Power Fail Detection
- .Logging of the number of Data Corrections that have occurred on a per unit basis
- .Disk Drive Power Sequencing
- .Delayed Power on Pick
- .Mix different Drive Formats
- .Extended Unit Select Address
- .Header CRC Auto Re-try

## 2.0 SPECIFICATIONS

### 2.1 INTERFACE

#### 2.1.1 DRIVE

Electrical: Standard SMD Interface

Driver/Receiver: Differential

Cabling: One 60-Conductor Shielded Round Cable ("A" cable)  
for the first disk drive (daisy-chained).

One 26-Conductor Shielded Round Cable ("B" cable)  
for the first disk drive (radial).

NOTE: Both cables connect to connectors on the board  
edge.

Multiple Drives: Up to four drives (CMD counts as two)  
per controller. The 60-pin "A" cable,  
daisy-chains from drive to drive, with  
the last drive in the chain receiving  
an "A" cable terminator. The 26-pin  
"B" cable connects radially to each  
drive. (No terminators required.)  
Reference Figure 3.8.

Performance:

#### 2.1.2 COMPUTER

The Controller is compatible with any Model DG Nova  
or Eclipse computer interface. Data transfer occurs  
over the standard or high-speed data channel.

## 2.2      POWER

+5 VDC @ 6.6 Amps

-5 VDC @ 0.7 Amps

## 2.3      PHYSICAL

Dimensions: 15 inches by 15 inches by 1/2 inch

Shipping Weight: 10 Pounds (3.7 kg.) includes cables,  
diagnostics and documentation.

Cables: 60-Pin "A" Cable - 15 feet

26-Pin "B" Cable - 15 feet

## 2.4      ENVIRONMENTAL

Operating Temperature: 0 to 55 degrees C

Relative Humidity: 10% to 90% (non-condensing)

Exceeds all Nova/Eclipse temperature and humidity  
specifications.

## 3.0        INSTALLATION

### 3.1        UNPACKING AND INSPECTION

All parts comprising of the Model 295 are shipped in one container consisting of:

- a) Controller
- b) Controller to Disk Drive Cabling
- c) Diagnostic Software
- d) Technical Manual

On receipt of the Model 295 from the carrier, inspect the shipping carton immediately for any evidence of damage or mishandling in transit.

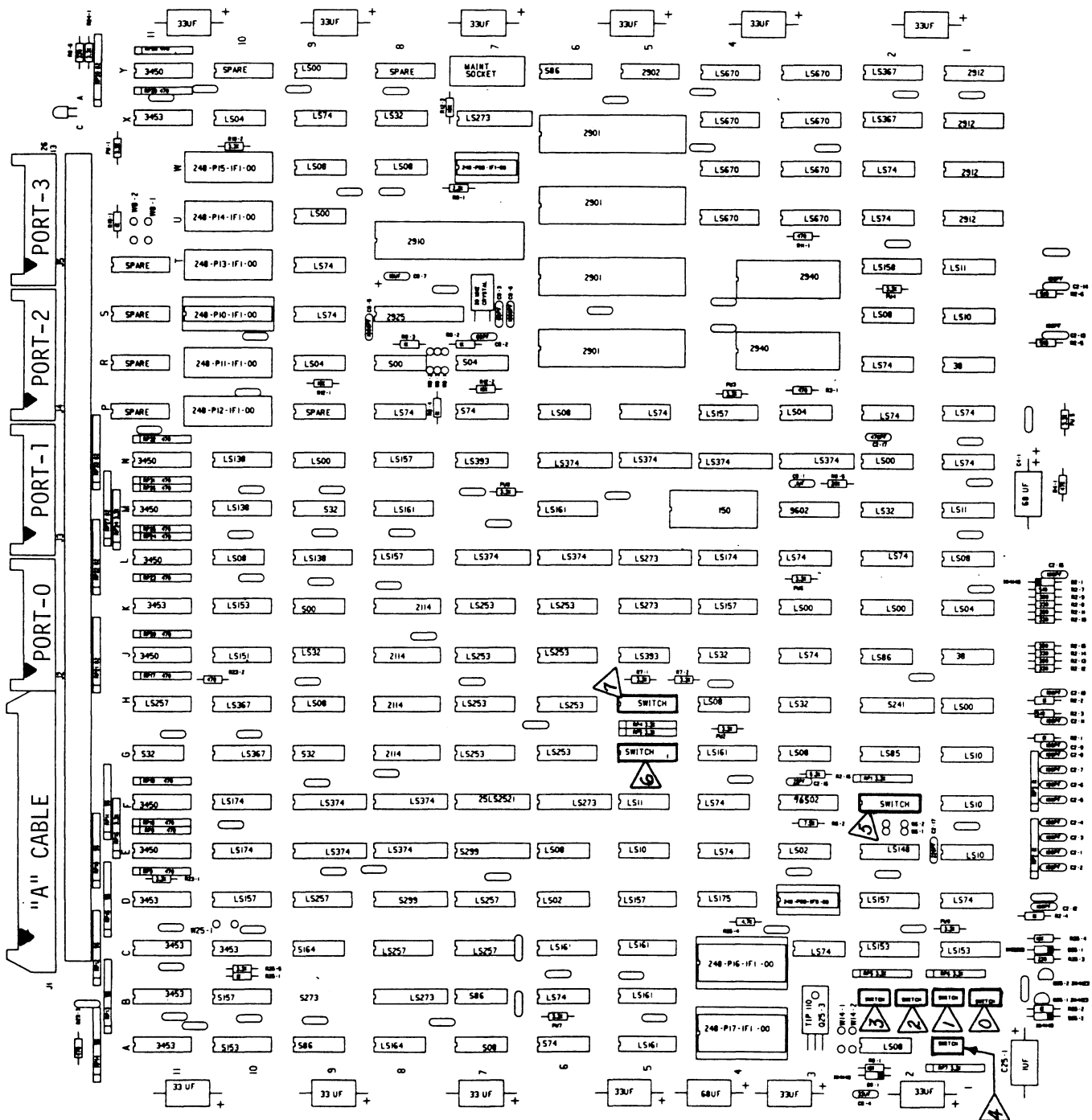
If the shipping carton is water stained or damaged, contact the carrier and shipper immediately, specify the nature and extent of the damage and request that the carrier's agent be present when the carton is opened.

ZETACO's warranty does not cover shipping damage.

For repair or replacement of any ZETACO product damaged in shipment, call ZETACO, Inc. to obtain return authorization instructions.

### 3.2        CONFIGURING THE 295 CONTROLLER

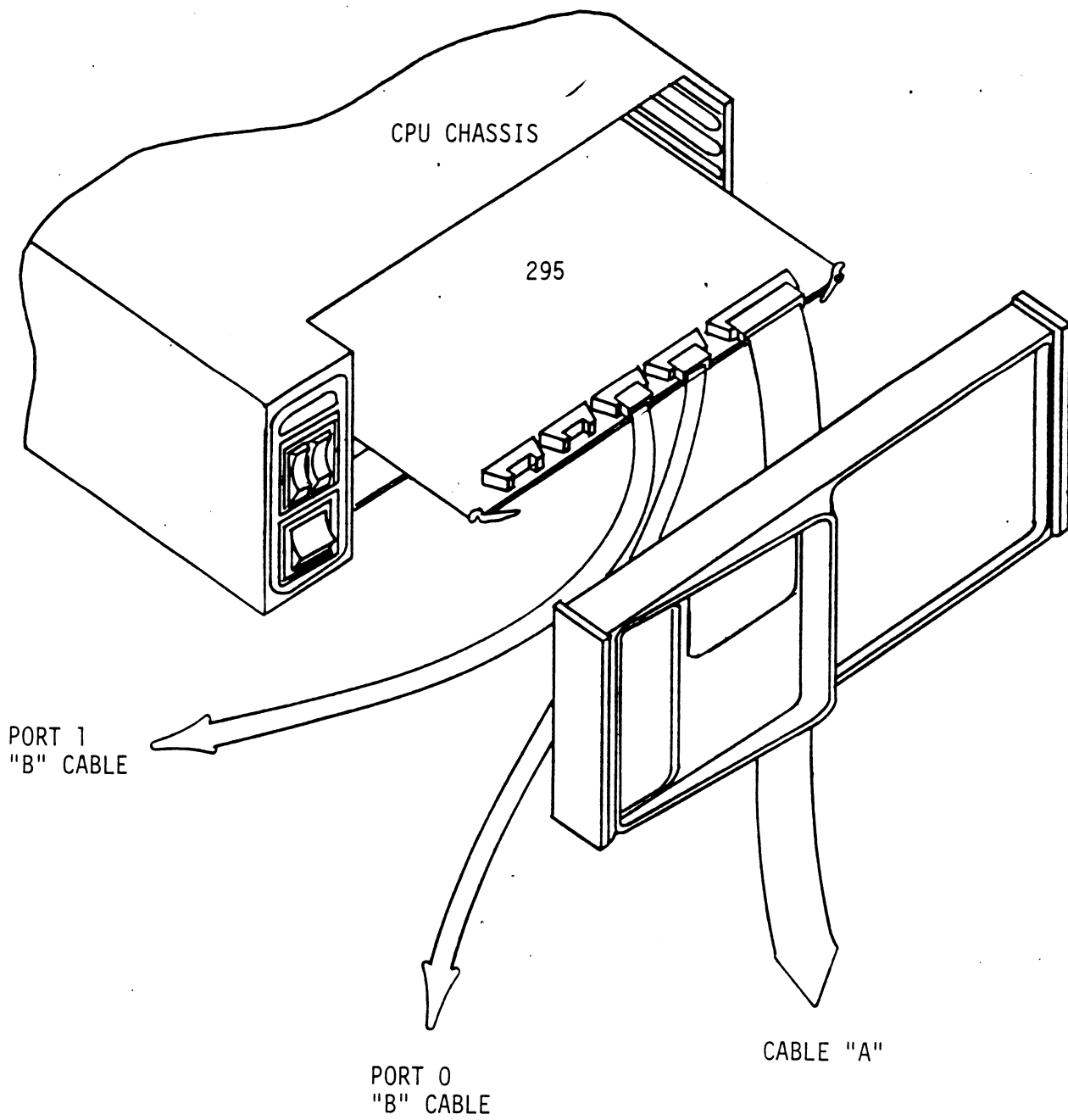
The configuration of the 295 is eased by having all options switch selectable. This section discusses each option switch and the meaning of each Switch's On and Off position. At the completion of Section 3.2 the configuration of the 295 will be completed. Refer to Figure 3.1 for the location of all referenced Switches and Port Connector Assignments.



- △ Port-0 Config. Switch
- △ Port-1 Config. Switch
- △ Port-2 Config. Switch
- △ Port 3 Config. Switch
- △ Bank Select Switch
- △ Device Code Switch
- △ Throttle & ECC Enable Switch
- △ Interleave and CMD Switch

- 8. ▲ Indicates Pin 1
- 9. All Unmarked Capacitors are .05 uf

BOARD LAYOUT  
Figure 3.1



BOARD DIAGRAM  
FIGURE 3.1.1



CABLE A

PORT 0

PORT 1

PORT 2

PORT 3



MODEL 295  
STORAGE MODULE  
DISK CONTROLLER

THROTTLE SETTING	
2 1 0	BURST RATE
X X X	2 WORDS
X X 0	4 WORDS
X 0 X	8 WORDS
X 0 0	16 WORDS
0 X X	32 WORDS
0 X 0	64 WORDS
0 0 X	128 WORDS
0 0 0	256 WORDS

X: ON  
0: OFF

NORMAL SETTING

THROTTLE 0  
THROTTLE 1  
THROTTLE 2  
NU  
NU  
NU  
EN ECC

MAINT SW  
MAINT SW  
NU  
CMB UNIT 0/1  
CMB UNIT 2/3  
SECTOR SKIP  
NU  
INTERLEAVE

G5 H5

PORT  
CONFIG  
SW'S

PC3 PORT 3  
PC2 B2B  
PC1  
PC0  
PC3 PORT 2  
PC1 B2A  
PC0  
PC3 PORT 1  
PC2 B1B  
PC1  
PC0  
PC3 PORT 0  
PC2 B1A  
PC1  
PC0

BANK  
SELECT

NU  
B2  
B2  
B2

A1

DEVICE  
SELECT

B5 0 (MSB)  
B5 1  
B5 2  
B5 3  
B5 4 (LSB)  
LOOP OR SECTEST  
DIS ALT FORMAT

F2

BOARD COVER  
FIGURE 3.1.2

### 3.2.1 SWITCH LOCATION F2 (REFERENCE FIGURE 3.2)

Switch Positions 1 thru 6 control the Device Code selection of the Controller. Any of the 77-8 possible device codes are selectable with the standard device codes being 27-8 Primary and 67-8 Secondary. Establish the desired device code.

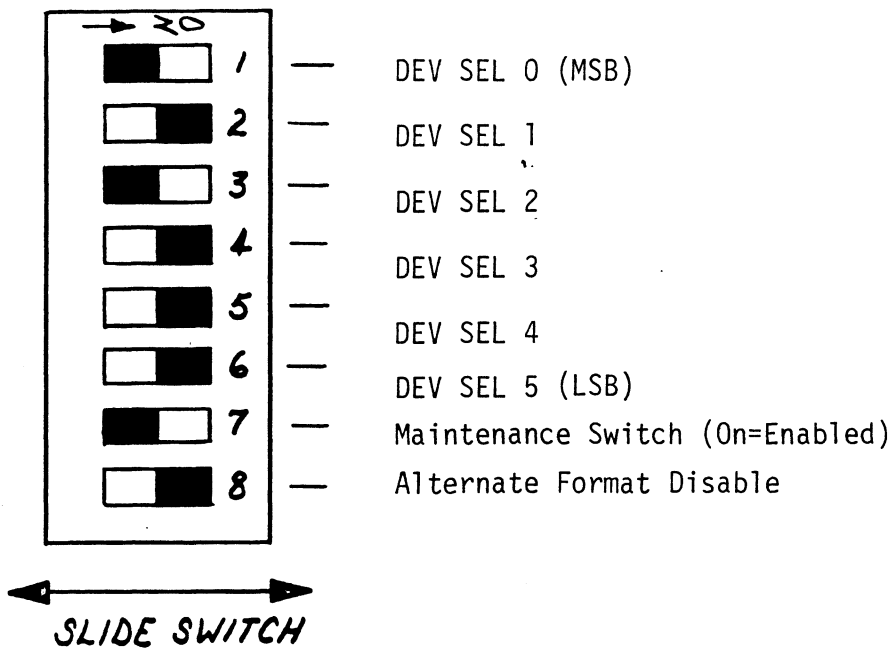
Switch Position 7 is used to control looping on the Controller's Self-test Feature. With the switch in the ON position the Self-test feature will operate continuously. With the switch in the OFF position the Self-test will occur once upon power-up. This switch must be in the OFF position.

Switch Position 8 controls the Mixed Drive Format feature. Normally, all four ports will use the same disk format. If this is desired set Switch 8 to the ON position. If a disk format is required on Ports 0 and 1 and a different disk format is required on Ports 2 and 3, set Switch 8 to the OFF position. Refer to Table 3.1 for Alternate Format Bank Selection. For detailed description of the Disk Formats reference Section 5.0.

### 3.2.2 SWITCH LOCATION A1 - BANK SELECT (REFERENCE FIGURE 3.3)

Switch Position 1 is reserved and must be in the ON position. Switch Position 2 through 4 select one of the seven possible Bank Selects (Reference Table 3.1).

In Table 3.1 the Bank Select numbers are on the horizontal (X) axis and the Port Configuration Select numbers are on the vertical (Y) axis. First decide which format will be used.



Location F2

Figure shows Device Code 27<sub>8</sub>,  
Maintenance Switch Off,  
Alternate Format Disabled.

Device Code	S1	S2	S3	S4	S5	S6
0X	OFF	OFF	OFF			
1X	OFF	OFF	ON			
2X	OFF	ON	OFF			
3X	OFF	ON	ON			
4X	ON	OFF	OFF			
5X	ON	OFF	ON			
6X	ON	ON	OFF			
7X	ON	ON	ON			
X0				OFF	OFF	OFF
X1				OFF	OFF	ON
X2				OFF	ON	OFF
X3				OFF	ON	ON
X4				ON	OFF	OFF
X5				ON	OFF	ON
X6				ON	ON	OFF
X7				ON	ON	ON

DEVICE CODE SELECT SWITCH

Figure 3.2

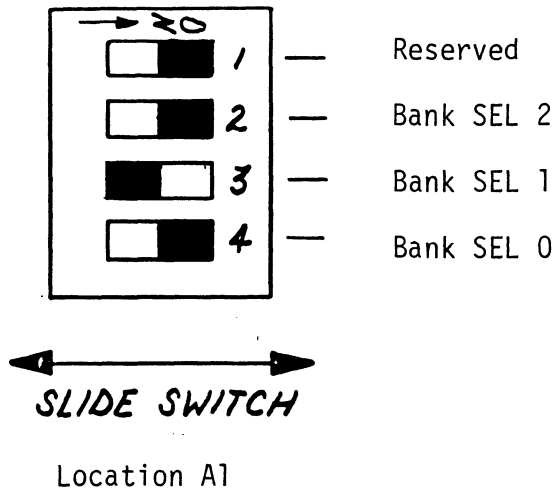


Figure shows bank two selected.

SW2	SW3	SW4	BANK SELECTED
ON	ON	ON	0
ON	ON	OFF	1
ON	OFF	ON	2
ON	OFF	OFF	3
OFF	ON	ON	4
OFF	ON	OFF	5
OFF	OFF	ON	6
OFF	OFF	OFF	7

BANK SELECT SWITCH

Figure 3.3

NOTE: Bank Select 1, 2 and 3 are ZETA Format  
Bank Select 4 and 5 are Alternate 1 Format  
Bank Select 6 is DG Format  
Bank 0 and 7 are reserved

Under each Bank Select is a list of disk drives. Locate which drives will be used, insuring they all come from within the same bank. When this process is done the Bank Select can be made.

### 3.2.3 PORT CONFIGURATION SWITCH SELECTION

Switch Locations	B1A - Port 0 (Reference Figure 3.4)
(Port Configuration Selection)	B1B - Port 1
	B2A - Port 2
	B2B - Port 3

Referring back to Section 3.2.2, a Disk Format was chosen as well as what disk drives would be attached. Decide which disk type will be attached to a respective Port. Set each Port Configuration Switch to the Port Configuration number that corresponds to the drive type that will be attached to that particular port.

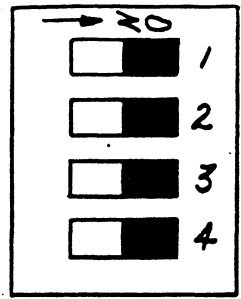
For example, it is desired to have ZETA format on all Ports and the following disk drives connected to -

Port 0 = CDC 9762

Port 1 = CDC 9766

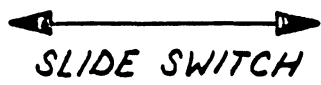
Port 2 = Ampex Capricorn 330

Table 3.1 indicates that these drives are all under Bank Select 1. Therefore, set the Bank Select Switch (location A1) to Bank 1. Set Port 0 Switch (location B1A) to Port Configuration 0, Port 1 to Port Configuration 1 and Port 2 to Port Configuration 7.



— Port Configuration 3  
 — Port Configuration 2  
 — Port Configuration 1  
 — Port Configuration 0

} Off=One  
 On=Zero



Location B1A - Port 0  
 Location B1B - Port 1  
 Location B2A - Port 2  
 Location B2B - Port 3

Configuration 0 shown.

SW1	SW2	SW3	SW4	PORT CONFIGURATION SELECT
ON	ON	ON	ON	0
ON	ON	ON	OFF	1
ON	ON	OFF	ON	2
ON	ON	OFF	OFF	3
ON	OFF	ON	ON	4
ON	OFF	ON	OFF	5
ON	OFF	OFF	ON	6
ON	OFF	OFF	OFF	7
OFF	ON	ON	ON	8
OFF	ON	ON	OFF	9
OFF	ON	OFF	ON	10
OFF	ON	OFF	OFF	11
OFF	OFF	ON	ON	12
OFF	OFF	ON	OFF	13
OFF	OFF	OFF	ON	14
OFF	OFF	OFF	OFF	15

PORT CONFIGURATION SWITCHES  
 Figure 3.4

BANK { PORT CONFIGURATION TABLE 3.1  
(60xx EMULATION)

BANK SELECT →

PORT CONFIGURATION SELECT ↓

	1	2	3
	ZETA PORT 0-3 ALT 1 PORT 2,3	ZETA PORT 0-3 ALT 1 PORT 2,3	ZETA PORT 0-3 ALT 1 PORT 2,3
0	• CDC 9762, RSD, 9730-80, C-D T82 • FUJITSU 2280, KENNEDY 5380, 7380 • AMPEX DM 980, SCORPIO-80 • TECSTOR 85-MEGAVULT 85 80 MB/32S	• CDC 9448-32 • AMPEX DFR 932 (REMOVABLE=0, FIXED=1) 16716 MB/32S	• NEC 2230 • KENNEDY 7340 40 MB/32S
1	• CDC 9766 • MEMOREX 677-30 • CENTURY 315, T306 • TECSTOR 300 300M/32S	• CDC 9448-32 • AMPEX DFR 932 (REMOVABLE=1, FIXED=0) 16716 MB/32S	• CDC 9448-64 • AMPEX DFR-64 (REMOVABLE=0, FIXED=1) 16716 MB/32S
2	• CDC 9730-160 • KENNEDY 53160 • CDC FSD • TECSTOR-165 • FUJITSU 2284 • AMPEX CAPRICORN-165 160 MB/32S	• CDC 9455-16 "LARK" (REMOVABLE=0, FIXED=1) 878 MB/32S	• CDC 9448-64 • AMPEX DFR-64 (REMOVABLE=1, FIXED=0) 16716 MB/32S
3	• CDC 9448 • AMPEX DFR 96 (REMOVABLE=0, FIXED=1) 16780 MB/32S	• CDC 9455-16 "LARK" REMOVABLE=1, FIXED=0) 878 MB/32S	• CDC 9775 2 UNITS 673 MB/32S
4	• CDC 9448 • AMPEX DFR 96 (REMOVABLE=1, FIXED=0) 16780 MB/32S	• PRIAM 3450 34 MB/23S	• AMPEX DM 160 160 MB/32S
5	• CDC 9455-48 "LARK" (REMOVABLE=0, FIXED=1) AMCODYNE 7110 2424 MB/32S	• TECSTOR 200 200 MB/32S	• CDC FSD 10B 340 MB/32S
6	• CDC 9455-48 "LARK" (REMOVABLE=1, FIXED=0) AMCODYNE 7110 2424 MB/32S	• MEMOREX 677-70 206 MB/23S	• NEC 2246 80 MB/35S
7	• FUJITSU 2294 • AMPEX CAPRICORN 330 330 MB/32S	• MEGAVULT 16 16 MB/32S	• NEC D2220 25 MB/32S
8	• CDC 9410-32 "FINCH" 32 MB/23S	• MEGAVULT 48 • AMPEX SCORPIO-50 48 MB/32S	• PRIAM 3330 34 MB/32S
9	• FUJITSU 2312 • MEMOREX 214 84 MB/32S	• MEGAVALT 116 116 MB/32S	• Priam 7050 70 Mb/23S
10	• FUJITSU 2311 • MEMOREX 213 48 MB/32S	• CENTURY C2048 (REMOVABLE=0, FIXED=1) 16732 MB/32S	• Priam 3450 34 Mb/23S
11	• PRIAM 6650/67 62 MB/32S	• CENTURY C2048 (REMOVABLE=1, FIXED=0) 16732 MB/32S	• CDC WINDSOR 70 Mb/32S
12	• PRIAM 15450 • DISCTRON 21600 145 MB/32S	• CDC 9410-B "FINCH" 8 MB/23S	
13	• PRIAM 309 106 MB/32S	• CDC 9410-24 "FINCH" 24 MB/23S	
14	• AMPEX 660 660 MB/32S	• CDC 9762, RSD, 9730-80 • FUJITSU 2280, KENNEDY 5380, 7380 • AMPEX DM 980, SCORPIO-80 • TECSTOR 85-MEGAVULT 85 80 MB/32S	
15		• MEGAVULT 212 212 MB/32S	

NOTE : BANK 0 RESERVED FOR SELFTEST

BANK SELECT →

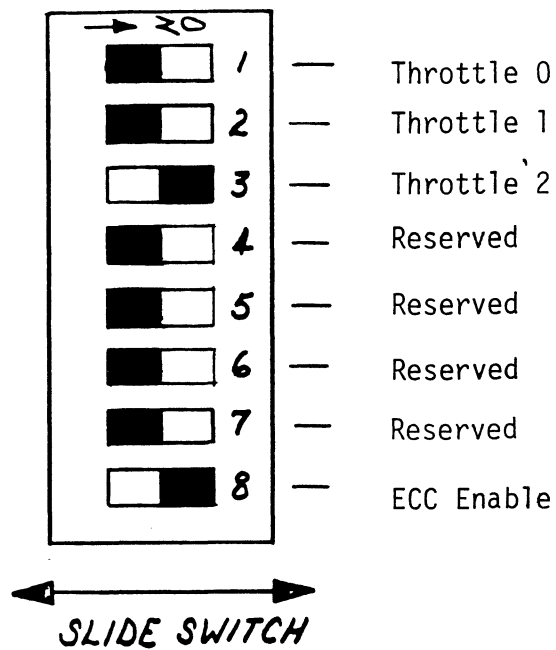
BANK PORT CONFIGURATION TABLE 3:1  
(60XX EMULATION)

PORT CONFIGURATION SELECT

	4	5	6	7
	ALT 1 PORT 0-3 D.G. PORT 2,3	ALT 1 PORT 0-3 D.G. PORT 2,3	D.G. PORT 0-3 ZETA PORT 2,3	RESERVED
0	<ul style="list-style-type: none"> <li>CDC 9762, 9730-80, RSD, CD T 32</li> <li>FUJITSU 2280, KENNEDY 5380, 7380</li> <li>AMPEX DM 980, SCORPIO-80</li> <li>TECSTOR 85-MEGAVULT 83</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">80MB/32S</div>	<ul style="list-style-type: none"> <li>CDC 9448-32</li> <li>AMPEX DFR 932</li> <li>(REMOVABLE=0, FIXED=1)</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">1616MB/32S</div>	<ul style="list-style-type: none"> <li>CDC 9762, RSD, 9730-80, CD T 32</li> <li>FUJITSU 2280, KENNEDY 5380, 7380</li> <li>AMPEX DM 980, SCORPIO-80</li> <li>TECSTOR 85-MEGAVULT 83</li> <li>(DOWNSIZED TO ZEBRA)</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">50MB/24S</div>	
1	<ul style="list-style-type: none"> <li>CDC 9766, MEMOREX 677-30</li> <li>CENTURY 315, T306</li> <li>TECSTOR 300</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">300M/32S</div>	<ul style="list-style-type: none"> <li>CDC 9448-32</li> <li>AMPEX DFR 932</li> <li>(REMOVABLE=1, FIXED=0)</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">1616MB/32S</div>	<ul style="list-style-type: none"> <li>CDC 9766, MEMOREX 677-30</li> <li>CENTURY 315, T306</li> <li>TECSTOR 300</li> <li>(DOWNSIZED TO ZEBRA)</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">192MB/24S</div>	
2	<ul style="list-style-type: none"> <li>CDC 9730-160, TECSTOR 165</li> <li>CDC FSD, FUJITSU 2284</li> <li>AMPEX CAPRICORN 165</li> <li>KENNEDY 53160</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">160MB/32S</div>	<ul style="list-style-type: none"> <li>CDC 9455-16 "LARK"</li> <li>(REMOVABLE=0, FIXED=1)</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">8/8MB/32S</div>	<ul style="list-style-type: none"> <li>CDC 9762, RSD, 9730, CD T 32</li> <li>FUJITSU 2280, KENNEDY 5380, 7380</li> <li>AMPEX DM 980, SCORPIO-80</li> <li>TECSTOR 85-MEGAVULT 83</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">80MB/32S</div>	
3	<ul style="list-style-type: none"> <li>CDC 9448</li> <li>AMPEX DFR 96</li> <li>(REMOVABLE=0, FIXED=1)</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">16180MB/32S</div>	<ul style="list-style-type: none"> <li>CDC 9455-16 "LARK"</li> <li>(REMOVABLE=1, FIXED=0)</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">8/8MB/32S</div>	<ul style="list-style-type: none"> <li>CDC 9766, MEMOREX 677-30</li> <li>CENTURY 315, T306</li> <li>TECSTOR 300</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">300MB/32S</div>	
4	<ul style="list-style-type: none"> <li>CDC 9448</li> <li>AMPEX DFR 96</li> <li>(REMOVABLE=1, FIXED=0)</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">16180MB/32S</div>	<ul style="list-style-type: none"> <li>PRIAM 3450</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">34MB/23S</div>	<ul style="list-style-type: none"> <li>CDC 9730-160, FUJITSU 2284</li> <li>CDC FSD, TECSTOR 165</li> <li>AMPEX CAPRICORN 165</li> <li>KENNEDY 53160</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">160MB/32S</div>	
5	<ul style="list-style-type: none"> <li>CDC 9455-48 "LARK"</li> <li>(REMOVABLE=0, FIXED=1)</li> <li>AMCODYNE 7110</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">24/24MB/32S</div>	<ul style="list-style-type: none"> <li>TECSTOR 200</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">200MB/32S</div>	<ul style="list-style-type: none"> <li>CDC 9455-16 "LARK"</li> <li>(REMOVABLE=0, FIXED=1)</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">8/8MB/32S</div>	
6	<ul style="list-style-type: none"> <li>CDC 9455-48 "LARK"</li> <li>(REMOVABLE=1, FIXED=0)</li> <li>AMCODYNE 7110</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">24/24MB/32S</div>	<ul style="list-style-type: none"> <li>MEMOREX 677-70</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">206MB/23S</div>	<ul style="list-style-type: none"> <li>CDC 9455-16 "LARK"</li> <li>(REMOVABLE=1, FIXED=0)</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">8/8MB/32S</div>	
7	<ul style="list-style-type: none"> <li>FUJITSU 2294</li> <li>AMPEX CAPRICORN 330</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">330MB/32S</div>	<ul style="list-style-type: none"> <li>MEGAVULT 16</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">16MB/32S</div>		
8	<ul style="list-style-type: none"> <li>CDC 9410-32 "FINCH"</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">32MB/23S</div>	<ul style="list-style-type: none"> <li>MEGAVULT 48</li> <li>AMPEX SCORPIO-50</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">48MB/32S</div>		
9	<ul style="list-style-type: none"> <li>FUJITSU 2312</li> <li>MEMOREX 214</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">84MB/32S</div>	<ul style="list-style-type: none"> <li>MEGAVULT 116</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">116MB/32S</div>		
10	<ul style="list-style-type: none"> <li>FUJITSU 2311</li> <li>MEMOREX 213</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">48MB/32S</div>	<ul style="list-style-type: none"> <li>CENTURY C2048</li> <li>(REMOVABLE=0, FIXED=1)</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">16/32MB/32S</div>		
11	<ul style="list-style-type: none"> <li>PRIAM 6650/67</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">62MB/32S</div>	<ul style="list-style-type: none"> <li>CENTURY C2048</li> <li>(REMOVABLE=1, FIXED=0)</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">16/32MB/32S</div>		
12	<ul style="list-style-type: none"> <li>PRIAM 15450</li> <li>DISLTRON 21800</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">145MB/32S</div>	<ul style="list-style-type: none"> <li>CDC 9410-8 "FINCH"</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">8MB/23S</div>		
13	<ul style="list-style-type: none"> <li>PRIAM 504</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">105MB/32S</div>	<ul style="list-style-type: none"> <li>CDC 9410-24 "FINCH"</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">24MB/23S</div>		
14	<ul style="list-style-type: none"> <li>AMPEX 660</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">60MB/32S</div>	<ul style="list-style-type: none"> <li>CDC 9762, 9730-80, RSD</li> <li>FUJITSU 2280, KENNEDY 5380, 7380</li> <li>AMPEX DM 980, SCORPIO-80</li> <li>TECSTOR 85-MEGAVULT 83</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">80MB/32S</div>		
15	<ul style="list-style-type: none"> <li>CDC FSD 9715</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">340MB/32S</div>	<ul style="list-style-type: none"> <li>MEGAVULT 212</li> </ul> <div style="border: 1px solid black; width: 100px; height: 15px; margin-top: 5px;">212MB/32S</div>		

NOTE: BANK 0 RESERVED FOR SELFTEST





Location G5

Throttle Setting of 16, Maintenance Switch  
Off, and ECC Enabled Shown.

THROTTLE SETTINGS

SW1	SW2	SW3	NUMBER OF WORDS
ON	ON	ON	2
OFF	ON	ON	4
ON	OFF	ON	8
OFF	OFF	ON	16
ON	ON	OFF	32
OFF	ON	OFF	64
ON	OFF	OFF	128
OFF	OFF	OFF	256

DATA CHANNEL THROTTLE SWITCH

Figure 3.5

#### 3.2.4 SWITCH LOCATION G5 (REFERENCE FIGURE 3.5)

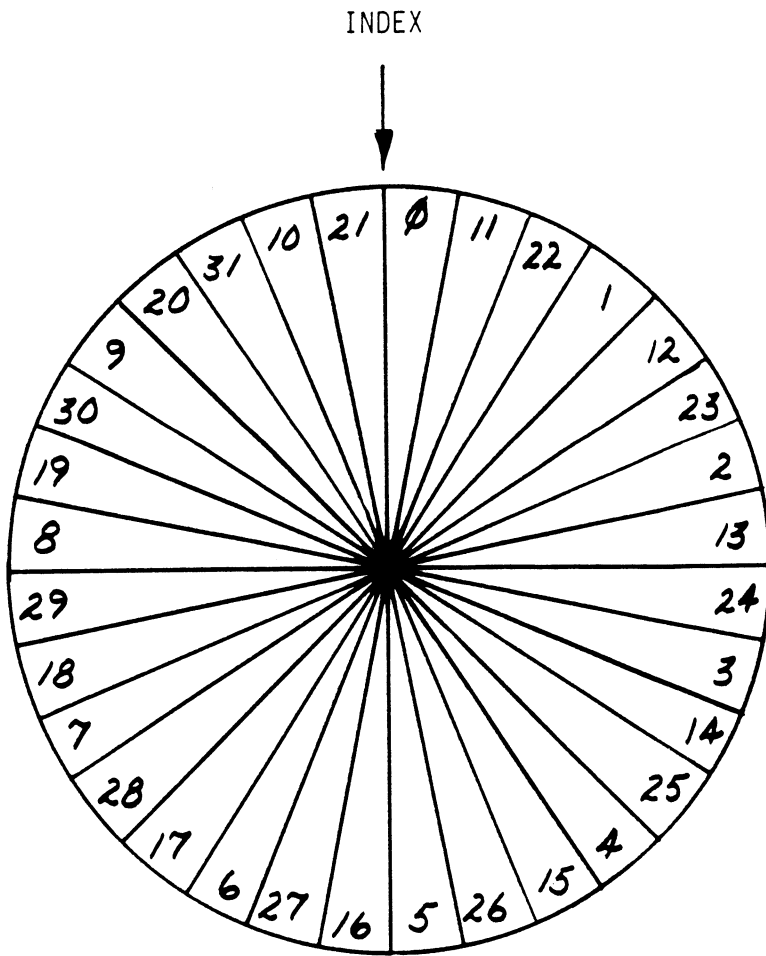
Switch Positions 1, 2 and 3 control the DMA Throttle Setting (i.e. the number of words that will be transferred per a Data Channel Access). Throttle adjustment is dependent on the type of system configuration the Controller is installed into. Too low of a throttle setting could result in slow disk performance and too high of a setting could cause a data late on another data channel device. Set the desired throttle setting (normally set to 16).

Switch Positions 4, 5 and 6 are reserved and must be in the OFF state.

Switch Position 8 is the ECC Enable Switch. When the ECC switch is ON, on-board error correction and Data Strobe Early/Late is enabled. A running count of ECC corrections and successful Data Strobe Early or Late Data Recoveries are logged in scratch pad memory (separate count for each unit). With the switch OFF, ECC corrections must be handled by the software. The hardware switch overrides the software enabled/disabled command. (To use the software commands, the switch must be in the ON position.) When changing the switch from an OFF to an ON position, IORESET Switch or Power OFF/ON must be depressed.

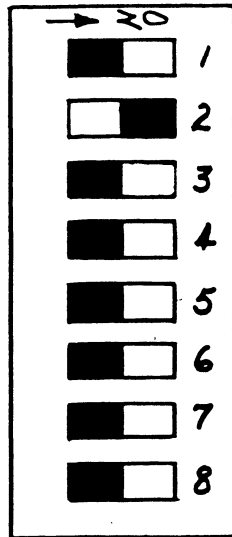
#### 3.2.5 SWITCH POSITION H5 (REFERENCE FIGURE 3.7)

Switch 1 enables looping on any subsection of Self-test that is failing. Switch 1 must be in the OFF position. In the OFF position you receive a short Self-test.



---

EXAMPLE FOR 32 SECTOR DISK  
Figure 3.6



- Maintenance Switch (On=Enabled)
- Maintenance Switch (On=Enabled)
- Reserved
- CMD Unit 0, 1
- CMD Unit 2, 3
- Reserved for Sector Slip
- Reserved
- Interleave

← SLIDE SWITCH →

Location H5

Interleave Off, No CMD's, Sector  
Verify On shown.

INTERLEAVE, CMD, SECTOR VERIFY SWITCHES

Figure 3.7

Switch 2 controls the run time of Self-test. When the switch is ON, the short version of the RAM test is run. When the switch is OFF the long version of the RAM test is run. Switch 2 should be in the ON position.

Switch 3 is reserved and must be OFF.

Switch 4 and 5 are used to inform the Microprocessor that CMD(s) are attached (CMD means any drive that incorporates two volumes, fixed and removable).

If a CMD is to be connected, the drive(s) unit number plug must be an even number. A CMD is treated as two logical units, so a maximum of 2 CMD's, or 1 CMD and 2 other drives can be connected.

If the CMD has logic plug 0 installed then Switch 4 must be ON and Switch 5 OFF. If the CMD has logic plug 2 installed then Switch 4 must be OFF and Switch 5 ON. If there are not any CMD's, then both Switch 4 and 5 must be OFF.

Switch 6 is reserved for Sector Slip.

Switch 6 and 7 are reserved and must be OFF.

Switch 8 enables the sector interleaving feature. When Switch 8 is ON it enables sector interleaving by a factor of 3. See Figure 3.6 for 32 sector example. This interleave factor eliminates the need for surface spiral and is restricted to operation with the number of sectors that meets the following equation:

$$(X + 1)/3 = 0 \text{ Remainder}$$

Where X = The desired number of sectors on the drive.

Interleaving may be desired to fine tune a systems performance. This is to avoid going a full revolution on the disk when the CPU cannot respond fast enough to catch the next sector.

When Switch 8 is in the OFF position the sector interleaving feature is disabled.

### 3.3 BOARD INSERTION

The 295 SMD is to be installed only after inspection and switch settings are verified. Carefully guide the Controller board into the desired slot by allowing the edges of the board to follow the guides evenly. Use the lock tabs on the two outside corners to provide leverage when the board meets the connector. Use equal pressure on both lock tabs until the board seats firmly into the backplane connectors.

### 3.4 PRIORITY SELECTION

The Controller must receive two priority signals from the Data General minicomputer backplane, Data Channel Priority In (Pin A94) and Interrupt Priority In (Pin A96). If there are vacant slots between the Controller and the processor, priority jumper wires must be installed to obtain priority continuity between controllers. To jumper across unused slots, connect A93 (Data Channel Priority Out) to A94 (Data Channel Priority In) and A95 (Interrupt Out) to A96 (Interrupt Priority In).

### 3.5 POWER FAIL PROTECTION

The 295 Disk Controller contains a double protection power fail scheme. The Data General CPU outputs a signal called "Power Fail" which gives an early warning of power loss. This is used on the DC-295 to disable the drives write circuitry through the open cable detect line.

To enable this power fail protection connect A47 of the 295 backplane slot to Pin A5 of a Nova 3 CPU backplane slot or A9 on a Nova 4 power supply slot.

In addition, the 295 contains power fail circuitry to further protect drive data integrity in the event the slot where the board is installed loses power.

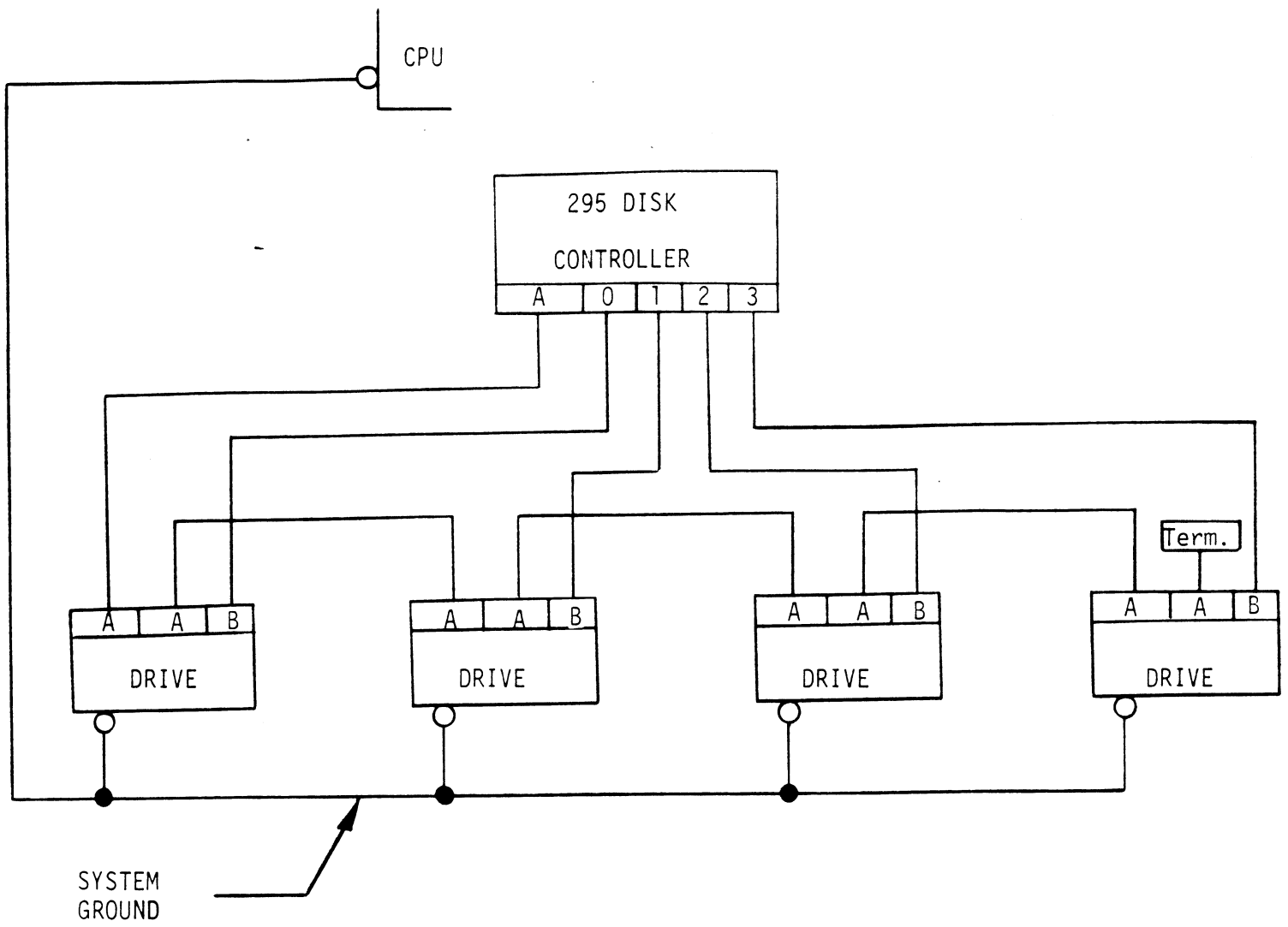
### 3.6 CABLING

Reference Figure 3.8 for proper cable connection and Figure 3.1 for Header Orientation.

Be sure to observe the arrows on the headers and plugs for proper orientation. As shown in Figure 3.8, the 60-pin "A" cable connects between J1 and the first drive and continues from drive to drive in a daisy-chain fashion. The last drive in the chain must have a terminator installed in place of the daisy-chain cable.

Each drive must have a 26-pin "B" cable connected between the drive and the Controller (J2-J5) in a radial fashion. Insure that the port configuration switches match the corresponding drive type plugged into its port.

Refer to the Drive Manufacturer's Manual for proper subsystem grounding if required.



DAISY-CHAINING DRIVES

Figure 3.8



### 3.6.1 SYSTEM GROUNDING

Because the power system safety ground does not necessarily satisfy all system grounding requirements, additional connections are required to earth ground, referred to as system ground. The Controller and its attached drive(s) must be connected to a single point ground system. Ground connections are made via ground braids that pass from drive-to-drive, drive-to-computer chassis and computer chassis-to-earth ground. **WARNING** - To ensure proper ground return to earth, each component in the system must be connected using a daisy chain ground system. Both the AC and DC grounds within each drive must be joined (consult drive manual). The drives must then be joined by a daisy-chain grounding braid and connected to the grounding post at the rear of the computer cabinet.

### 3.7 DRIVE PICK/HOLD

Upon initial power-up, the Controller will delay activating Pick/Hold (spins up drive) for one second. This feature eases the initial current demand on the AC power source.

## 4.0 PROGRAM CONTROL

### 4.1 INSTRUCTION FORMAT

Symbolic form for I/O instructions:

DXXF AC, DSKP

DXX - DOA, DOB, DOC, DIA, DIB, DIC

F = Function:

- C (Clear)           - Resets BUSY and DONE flags to zero, aborts all data transfer commands, and clears Data Transfer Status (DIA) fault bits 6, 7, 8, 9, 10, 11, 12, 13, 14 & 15. Also clears RD/WRT and Drive Attention Flags and Interrupt Request.
- S (Start)           - Sets BUSY flag, clears DONE and initiates one of the following commands selected by a DOA: READ, WRITE, FORMAT, READ BUFFERS or VERIFY. Also clears Interrupt Request and Data Transfer Status (DIA) fault bits 6, 7, 8, 9, 10, 11, 12, 13, 14 & 15.
- P (Pulse)           - Sets CONTROL FULL flag and initiates one of the following commands selected by a DOA: RECAL, SEEK, STOP, OFFSET, WRITE DISABLE, RELEASE, TRESPASS AND EXAM CONTROLLER RAM.

AC = Accumulator: 0, 1, 2 or 3.

DSKP = Device Code: Primary - 27 Octal

Secondary - 67 Octal

(Other available by switches)

### BINARY REPRESENTATION OF AN I/O INSTRUCTION

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	1	AC	OP CODE			FUNC		DEVICE CODE						

INTERRUPT MASK BIT 7

MSKO AC

Execution of the Mask Instruction with Bit 7 equal to a one in the selected accumulator will set the interrupt mask within the Controller board. This will inhibit any further interrupt requests by the Controller until the interrupt mask is cleared, either by an IORST instruction or execution of the mask instruction with accumulator Bit 7 equal to a zero.

IORESET INSTRUCTION

IORST

Execution of an IORST instruction serves as a master reset to the Controller board. Upon completion of an IORST the Controller will attempt to select unit zero and default the command register to a read operation.

## IOSKIP INSTRUCTION

Used to poll the state of the Controller board (command is DONE or BUSY). If the skip condition is met the next instruction is skipped, otherwise the next instruction is executed.

SKPBZ DSKP - SKIP IF BUSY FLIP-FLOP IS CLEAR.

SKPBN DSKP - SKIP IF BUSY FLIP-FLOP IS SET.

SKPDZ DSKP - SKIP IF DONE FLIP-FLOP IS CLEAR.

SKPDN DSKP - SKIP IF DONE FLIP-FLOP IS SET.

## 4.2 ACCUMULATOR FORMATS

### 4.2.1 DOA - SPECIFY COMMAND AND DRIVE

DOAF AC, DSKP

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

0	1	1	AC	0	1	0	F	DEVICE CODE							
---	---	---	----	---	---	---	---	-------------	--	--	--	--	--	--	--

Accumulator

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

R/W DN	CLR SEEK DONE		COMMAND				DRIVE		NOT USED					
-----------	------------------	--	---------	--	--	--	-------	--	----------	--	--	--	--	--

### BIT POSITION

- 0 - Clear Read/Write Done if it is a ONE
- 1 - Clear Seek Done Attention Flag for Drive Unit 0 if it is a ONE
- 2 - Clear Seek Done Attention Flag for Drive Unit 1 if it is a ONE
- 3 - Clear Seek Done Attention Flag for Drive Unit 2 if it is a ONE
- 4 - Clear Seek Done Attention Flag for Drive Unit 3 if it is a ONE
- 5 - 8 Specify Command

FUNCTION REQUIRED  
TO INITIATE

0000	READ	START
0001	RECALIBRATE	PULSE
0010	SEEK	PULSE
0011	STOP DISC	PULSE
0100	OFFSET FORWARD	PULSE
0101	OFFSET REVERSE	PULSE
0110	WRITE DISABLE	PULSE
0111	RELEASE DRIVE	PULSE
1000	TRESPASS	PULSE
1001	SET ALT MODE 1	NONE
1010	SET ALT MODE 2	NONE
1011	EXAMINE RAM	PULSE
1100	DATA VERIFY	START
1101	READ BUFFERS	START
1110	WRITE	START
1111	FORMAT	START

NOTE: See Section 4.3 for detailed command description

9 - 10 Drive Selection

00 - Drive Unit 0

01 - Drive Unit 1

10 - Drive Unit 2

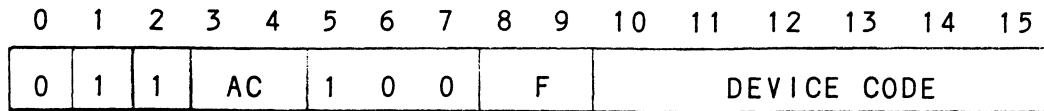
11 - Drive Unit 3

DOA will reserve a previously unreserved drive

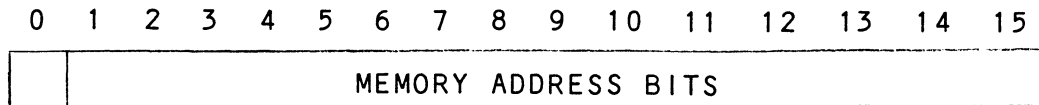
11-15 Reserved for future consideration

#### 4.2.2 DOB - LOAD STARTING MEMORY ADDRESS

DOBF AC, DSKP



Accumulator

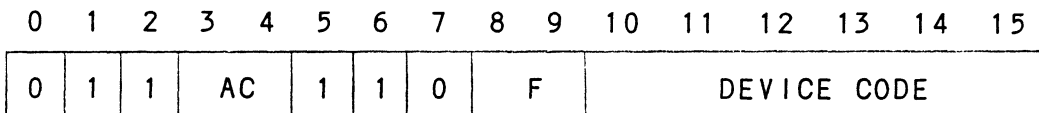


↑ EXTENDED MEMORY ADDRESS BIT

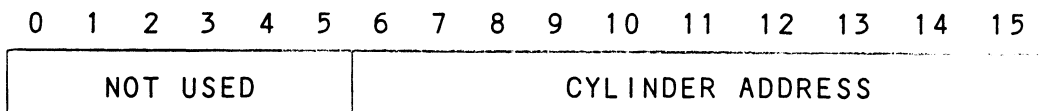
Execution of this instruction will load the controllers address counter with the contents of the specified accumulator and will be used as the starting memory address for a command that requires a data channel transfer operation.

#### 4.2.3 DOC - LOAD DRIVE ADDRESS

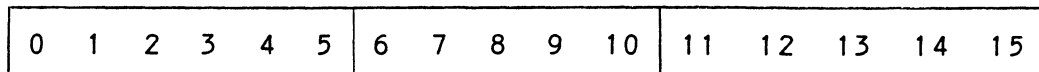
DOCF AC, DSKP



Accumulator (if previous DOA specified a Seek)



Accumulator (if previous DOA specified a Read, Write, Format or Data Verify)



- 0 - Not Used
- 1 - 5 Starting Surface Address
- 6 - 10 Starting Sector Address
- 11-15 Two's complement of number of sectors to be transferred

#### 4.2.4 READ STATUS - NON ALTERNATE MODE

##### 4.2.4.1 DIA - READ DATA TRANSFER STATUS

DIAF, AC, DSKP

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	1	AC	0	0	1	F	DEVICE CODE							

Accumulator

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
---	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----

- 0 - Control Full
- 1 - R/W Done
- 2 - Unit 0 Atten Done
- 3 - Unit 1 Atten Done
- 4 - Unit 2 Atten Done
- 5 - Unit 3 Atten Done
- 6 - Bus Error
- 7 - Illegal Sector Adr
- 8 - ECC Error
- 9 - Bad Sector Flag
- 10 - Cyl Addr Error
- 11 - Surf/Sect Addr Error
- 12 - Verify Error
- 13 - R/W Timeout
- 14 - Data Late
- 15 - Read/Write Fault

0	CONTROL FULL	Will be a one when the controller receives a pulse function. Will be a zero once the controller completes the function to the drive that was specified by the command (Recal, Seek, Stop Disk, Offset, WRT DIS, Release, Trespass and Exam Ram).
1	R/W DONE	A one indicates that the done flag was set following a data transfer command.
2-5	UNIT ATTEN DONE (UNITS 0-3)	A one indicates that the respective drive completed a successful seek or recalibrate operation. If the drive was unsuccessful in its attempt to seek, a positioner fault status will be indicated. A recalibrate operation will clear the fault.
6	BUS ERROR	An incorrect number of memory transfers resulted on the data channel when set to a one.
7	ILLEGAL SECTOR ADDR	The starting sector address (DOC) exceeded the capacity of the drive if set to a one. Done sets immediately.



- 8           ECC ERROR           A sector of data read from the disk did not correlate with the appended polynomial. This means that the data read does not agree with the data that was originally written.
- 9           BAD SECTOR FLAG       The controller detected the bad sector flag set to a one within the sectors address header. (DONE will set immediately). This implies that the format program originally determined that the surface within this sector could not support errorless data.
- 10          CYLINDER ADDRESS ERROR   The Cylinder Address contained within the Sectors Header did not match the requested cylinder given by the previous SEEK command. Bit 11 will set, instead, if there is no match due to a media flaw. The Read/Write Operation will be terminated immediately.

11	SURFACE/ SECTOR ADDRESS ERROR	<p>This status bit may be set by one of the following cases:</p> <ol style="list-style-type: none"> <li>1) The Surface or the Sector Address contained within the Sectors Header did not match the current contents of the Controller's Surface/Sector Register (initiated by a DOC).</li> <li>2) The CRC polynomial did not correlate with the Header Address.</li> <li>3) The Data Sync on a READ command could not be detected.</li> </ol> <p>The Read/Write operation will be terminated immediately.</p>
12	VERIFY ERROR	Data in memory did not agree with the data on the disk. (See VERIFY Command).
13	READ/WRITE TIMEOUT	A READ or WRITE type of operation did not complete within one second.
14	DATA LATE	Not implemented.
15	READ/WRITE FAULT FLAG	A ONE indicates that at least one bit is set in bit positions 6 through 14 or a drive fault occurred during a Read/Write transfer operation.

Refer to TABLE 4.1 for detailed description.

	STATUS BIT POSITION	CONTROLLER ACTION	ERROR RECOVERY
BUS ERROR	6	Sets done immediately	New command re-try Read/Write Transfer. May correct the problem.
ILLEGAL SECTOR ADDRESS	7	Sets done immediately	New command if error re- occurs. Check the drive characteristic switches to make sure it agrees with drive type.
ECC ERROR	8	Sets done at the end of sector transfer	New command. Re-tries with servo offset may correct the data. If this error is detected on a surface analysis, the bad sector flag should be set.
BAD SECTOR FLAG	9	Sets done immediately	New command. This sector should be ignored.
CYLINDER ADDRESS ERROR	10	Sets done immediately	New command. The system should diagnose this as a positioner fault.
SURF/ SECTOR ADDRESS ERROR	11	Sets done immediately	New command. Bad sector flag should be set if surface analysis.
VERIFY ERROR	12	Sets done at the end of the sector transfer	New command. Check ECC error also to determine if the error occurred due to a flaw in the media.
READ/ WRITE TIMEOUT	13	Sets done immediately	New command.

READ/WRITE FAULTS (DIA)

TABLE 4.1

#### 4.2.4.2 DIB - READ DRIVE STATUS

DIB AC, DSKP

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	1	AC	0	1	1	F	DEVICE CODE							

Accumulator

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
---	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----

- 0 - Invalid Status
- 1 - Drive Reserved
- 2 - Trespassed
- 3 - Ready
- 4 - Busy
- 5 - Positioner Offset
- 6 - Write Disabled
- 7 - Not Used
- 8 - Ill Sur/Cyl Addr
- 9 - Illegal Command
- 10 - DC Voltage Fault
- 11 - Pack Unsafe
- 12 - Positioner Fault
- 13 - Servo Clock Fault
- 14 - Write Fault
- 15 - Drive Fault

0	INVALID STATUS	A one indicates that Status Bits 1 through 15 should be ignored because the drive is not selected or it is in the process of being selected.
1	DRIVE RESERVED	In a dual port configuration the selected drive is currently in use by another processor.
2	TRESPASSED	Not implemented.
3	READY	Drive unit specified by a previous DOA command is selected, spindle is up to speed and positioner is on cylinder.
4	BUSY	The positioner within the currently selected drive is not on cylinder.
5	POSITIONER OFFSET	The selected Read/Write head was moved from on cylinder dead center as was specified by an offset forward or reverse command.
6	WRITE DISABLED	Status from the drive indicates that a write type of command cannot be executed.
7	NOT USED	
8	ILLEGAL SURFACE OR CYLINDER ADDRESS	The requested surface or cylinder address exceeds the capacity of the drive. Read/Write operation will terminate immediately.



9	ILLEGAL COMMAND	The Controller was requested to perform a WRITE type of command while servo is offset or WRITE DISABLED is active.
10	DC VOLTAGE FAULT	Not implemented.
11	PACK UNSAFE	Conditions exists within the drive which may impair the safety of the media. This bit will be a one if a fault status is received directly from the drive interface.
12	POSITIONER FAULT	This indicates that the drive was unable to complete a SEEK within 500 ms, or that the positioner has moved to a position outside the recording field. The system should send a recal command to recover from this error.
13	SERVO CLOCK FAULT	A clock synchronization failure occurred between the serial data being read and the reference clock coming from the disk drive. In most cases this means that the header or data sync was not encountered within a specified amount of time.

This flag would set if the format on the disk did not agree with what the Controller expected. Check the switch settings to make sure the proper format was selected

- 14           WRITE FAULT       An abnormal condition was detected by the drive during a write type of operation.
- 15           DRIVE FAULT       One or more bits are set in positions 8 through 14 or the drive detected an abnormal condition.

Refer to TABLE 4.2 for more detailed description.

4.2.4.3 DIC - READ SURFACE, SECTOR AND COUNT

DICF AC, DSKP

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	1	1	AC	1	0	1	F	DEVICE CODE							

Accumulator

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
NU	CURRENT SURFACE ADDR					CURRENT SECTOR ADDR					TWO'S COMPLEMENT OF NUMBER OF SECTORS REMAINING				

4.2.5 READ STATUS - ALTERNATE MODE ONE

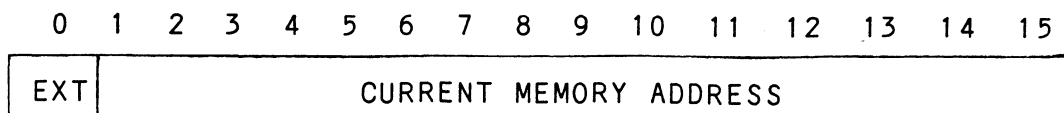
See detailed description of Alternate Mode One Command. Previous DOA specified ALT Mode One for Sections 4.2.5.1 through 4.2.5.3.



#### 4.2.5.1 DIA - READ CURRENT MEMORY ADDRESS

DIAF AC, DSKP

Accumulator



After the execution of this instruction the value of the accumulator will contain the memory address to where the next data word transfer will take place. The memory address counter is incremented by one after each data channel transfer.

#### 4.2.5.2 DIB - READ EXTENDED MEMORY ADDRESS

Not currently implemented. Execution of this instruction will result in all zeros.

#### 4.2.5.3 DIC - NOT CURRENTLY IMPLEMENTED

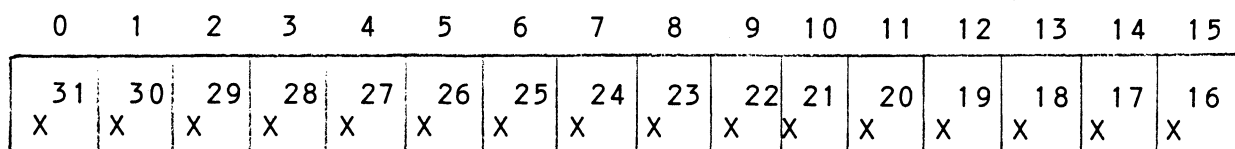
#### 4.2.6 READ STATUS - ALTERNATE MODE TWO

See detailed description of Alternate Mode Two Command. Previous DOA specified ALT Mode Two for Sections 4.2.6.1 through 4.2.6.3.

#### 4.2.6.1 DIA - READ ECC REMAINDER UPPER

DIAF AC, DSKP

Accumulator



STATUS BIT POSITION	CONTROLLER ACTION	ERROR RECOVERY	DRIVE ACTION
ILLEGAL SURFACE	8	Command is rejected and Done is set immediately.	New Command None
ILLEGAL CYLINDER	8	Seek Command is rejected.	New Seek or Recall Command None
ILLEGAL COMMAND	9	Command is rejected and Done is set immediately.	New Command None
PACK UNSAFE	11	Command is terminated.	A Recall Command, if the controller caused the Fault (i.e. exceeding the Surface or Cylinder Address or Write Command while Write is disabled). Fault status is issued to controller. Refer to Drive Manufacturer's Specifications for Faults that cannot be cleared by Fault Clear (Recal) from the controller.
POSITIONER FAULT	12	If it is detected at the start of a Read or Write Command, Pack Unsafe will also Set and the Command will terminate immediately.	Recal Command Fault Status is issued to the controller along with Seek Error.
SERVO CLOCK	13	Read/Write Command is terminated immediately.	Reformat the surface or select the proper format on the controller. The format on the surface did not agree with the format selected on the controller. None

DRIVE FAULT TABLE (DIB)

TABLE 4.2

#### 4.2.6.2 DIB - READ ECC REMAINDER LOWER

DIBF AC, DSKP

Accumulator

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

#### 4.2.6.3 DIC - NOT CURRENTLY IMPLEMENTED

### 4.3 DETAILED COMMAND DESCRIPTIONS

The command set (16 in all) provided by the controller is basically broken up into three groups:

1. Data Transfer Command
2. Drive Commands
3. Alternate Mode Commands

The Command is stored in the controller via a DOA instruction. Before any Command is initiated, the selected Unit must have valid status and be ready.

#### 4.3.1 DATA TRANSFER COMMANDS

Start (Set Busy) will initiate any one of the following commands: Read, Write, Format, Verify or Read Buffers up to 32 contiguous sectors may be transferred.

#### Read/Write Initialization Steps:

1. Control full and Drive status must be tested for proper state before commencing with a Read/Write Command.
2. Send the Starting Surface and Sector Address along with the two's complement of the number of sectors transferred. (See DOC)
3. Send the Starting Memory Address of where the data should be stored or retrieved. (See DOB)
4. Send the Command type and the desired Drive Unit Number. (See DOA)
5. Issue a Start Pulse.

#### Read/Write Termination Possibilities (Done Set):

1. All the sectors implied by the two's complement sector count were transferred.
2. A Drive or Read/Write Error was encountered. DIC command should be issued to determine which sector the error occurred at.
3. Busy was cleared by an IORESET instruction or a clear pulse was issued to the controller during the Read/Write transfer. Done will not set in this case.

#### 4.3.1.1 READ COMMAND

When busy sets, the controller will wait for on cylinder if the previous seek command has not been completed yet. It will then search for the starting sector address specified by the previous DOC instruction. The header is read and compared with the starting sector address, starting surface address and stored cylinder address to insure that the proper sector has been physically located. Before the data can be accepted the header must match the specified address, the header CRC must be good and no bad sector flags encountered. If the header is in error or the bad sector flag is a one, the appropriate status bit and done flag is set immediately. When the drives RD/WRT head reaches the data field the serial data is sent to the SMD interface formed into parallel words by the controller and transferred to the buffer. When all 256 words are contained within the buffer, the ECC Code appended in the data is checked to insure proper data by reading the results of the remainder. A data error occurred if the remainder is not equal to zero. In the case of an error the controller will transfer the data into memory and then set ECC Error Flag and Done. If the ECC Enable switch was closed (refer to switch settings), the controller will attempt to correct the data within its own buffer prior to transferring it to memory.

If it determines that it is not correctable, the Controller will re-try on its own with a Data Strobe Early and if unsuccessful, again with a Data Strobe Late. If the data is still not correctable, then it will set ECC Error Flag and DONE. If more sectors are to be transferred, the Controller will begin searching for the next sector while the data from the previous sector is transferred to memory.

#### 4.3.1.2 WRITE COMMAND

When BUSY sets, the Controller will wait for the positioner to be on cylinder if the selected drive is still in the process of SEEKING. Upon the completion of the previous SEEK operation, the Controller will transfer 256 words of data from memory to a sector buffer. The starting address of memory was specified by the previous DOB instruction. The Controller searches for the desired sector and performs a HEAD VERIFICATION (same as the READ command) before data is written on to the surface of the disk. Once the correct sector is found, the Controller will select the sector buffer previously written by the data channel control. The contents of this buffer is then written on to the disk surface preceded by a gap and data sync. The Controller incorporates two sector buffers. Therefore, the data channel logic can write into one buffer while data is transferred to the disk from the other.

#### 4.3.1.3 VERIFY

When BUSY sets, the Controller initially starts out as if it were a READ command (i.e. wait for on cylinder, verify header etc). Once a full sector is transferred from the disk to a controller buffer a comparison is made against system memory. This is accomplished by reading a word from memory starting from the previous DOB and comparing each word of sector. If a word does not compare, data transfer status (DIA) Bit 12 and Done will set.

#### 4.3.1.4 FORMAT

The objective of the Format Command is to write the header information (surface, sector and cylinder address) on a sector. Up to 32 contiguous sectors may be formatted per command. Data that was contained within the sector will be lost (replaced by all zeros). Refer to Figure 5.2 for format details. Format is also used to set the bad sector flag.

#### 4.3.1.5 READ BUFFERS

Reads the contents of the currently used buffer and transfers all 256 words to memory specified by the starting address. Primarily used for diagnostic purposes.

#### 4.3.2 DRIVE COMMANDS

IOPULSE (sets Control Full) initiates any one of the following commands: RECALIBRATE, SEEK, STOP, OFFSET, WRITE DISABLE, RELEASE, EXAMINE RAM and TRESPASS.

#### 4.3.2.1 RECALIBRATE

Moves the heads to cylinder 0, selects Head 0, and issues a fault clear to the drive.

An IORESET switch will automatically cause a recalibrate command to be issued to Unit 0.

This command moves the heads more slowly than a SEEK to 0, so it should not be used for data acquisition.

#### 4.3.2.2 SEEK

Moves the heads to the cylinder specified by the DOC. The Controller stores the cylinder address for that particular unit, initiates the SEEK operation and clears Control Full. While that unit is busy seeking the Controller can accept another SEEK command for a different unit (overlapped seeks) or commence with a Read/Write Command for the unit busy seeking. See the SMD specification for the SEEK TIMING.

#### 4.3.2.3 OFFSET FORWARD

Offsets the heads forward off the track center-line. This operation is cleared by the next command. (The drive does not allow WRITE operations when the positioner is offset).

#### 4.3.2.4 OFFSET REVERSE

Offsets the heads reverse off the track center-line. This operation is cleared by the next command. (The drive does not allow WRITE operations when the positioner is offset.) Offset forward or reverse may be used as an attempt to recover data that cannot be corrected by the error correction algorithm.



#### 4.3.2.5 WRITE DISABLE

Not Implemented.

#### 4.3.2.6 RELEASE DRIVE

Clears the reserved condition of the specified drive which this processor had previously reserved.

#### 4.3.2.7 TRESPASS

The Controller issues a priority select to the specified drive. The drive will immediately be reserved until a RELEASE command is issued or the Drive Timeout feature times out.

#### 4.3.2.8 STOP DISK

All drives connected that are selected for remote operation will unload the heads and spin down via the Pick/Hold line. A console reset, IORESET instruction, or another command will spin the disk back up.

#### 4.3.2.9 EXAMINE RAM COMMAND

This command gives the system the capability of reading from or writing to the DC-295 Controller's memory. This command must be preceded by a DOC containing the address of the desired RAM location.

In order to write to RAM, Bit 0 (MSB) must be a ONE in the DOC address, and the data to be written is sent via the DOB. If a read RAM is implied (DOC Bit 0 = 0), the contents of the DIC will contain the RAM data after Control Full clears.

This feature is used for obtaining the following information:

- a. Drive characteristics for the Formatter and Reliability programs.
- b. Number of ECC corrections by the Controller (each unit has a separate count).
- c. Maintenance testing.
- d. Features that may be considered in the future.

#### DETAILED DESCRIPTIONS OF USER RAM LOCATIONS

OCTAL ADDRESS	NAME	DESCRIPTION
1422	DISABLE CORRECTION	The least significant bit is used to indicate if controller self corrections are permitted. This bit will be initialized on a power on or an IORESET switch. If the ECC switch (G5 SW Position 8) is ON it will be initialized to a zero, if it is OFF it will be initialized to a ONE. If one is written into this bit, correction will be software disabled. Correction cannot be software enabled if the ECC Enable switch is OFF.

1460-1462

SELECTED  
DRIVE  
CHARACTERISTICS

These locations will be updated whenever a new drive is selected.

1460 - Maximum sector address

1461 - Maximum surface address

1462 - Maximum cylinder address

Allow invalid status to go away before a reference is made. Avoid writing to these locations.

1500-1503

UNIT  
CORRECTION  
COUNTS

These locations will be incremented each time the controller does a correction either by the ECC algorithm or an Early/Late re-try. The maximum count per unit is 65535 (the count will stay at maximum if there are any more corrections to that unit). The counts are initialized to zero on either a power on or an IORESET switch.

A separate count is maintained for each unit.

1500 - Unit 0

1501 - Unit 1

1502 - Unit 2

1503 - Unit 3

EXAMINE RAM COMMAND

1776-8 EEPROM REVISION LEVEL

DIC ACCUMULATOR

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

0	0	0	0	0	0	0	0	REVISION LEVEL							
---	---	---	---	---	---	---	---	----------------	--	--	--	--	--	--	--

EXAMPLE: Revision Level 6 EEPROMS

Location 1776-8 = 000006-8

1777-8 PROM ID/REV

DIC ACCUMULATOR

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

0	R E S	IDENTIFICATION						REVISION LEVEL							
---	-------------	----------------	--	--	--	--	--	----------------	--	--	--	--	--	--	--

EXAMPLE: Identification 1 Revision Level B

Location 1777-8 = 000413-8

NOTE: Avoid referencing any locations that are not defined here.

EXAM RAM EXAMPLE

READ Contents of Loc 1500 Octal (Unit 0 corrections)

Accumulator Set up:

A0 = 002600 (NOP Command Unit 0)  
A1 = 001500 (RAM Address for DOC)

```

DOC 1, DSKP           ; Send RAM Address
DOAP 0, DSKP          ; Send NOP Command and IOPULSE
DIA 0, DSKP           ; Wait for Control Full
MOVZL# 0,0,SZC        ; To be zero
JMP .-2
DIC 2, DSKP           ; Put contents of RAM Location
                       ; 1500 into Accumulator 2
    
```

WRITE To Location 1500 Octal (Clear Unit 0 Corrections)

Accumulator set up:

A0 = 002600 (NOP Command Unit 0)  
A1 = 101500 (RAM Address for DOC)  
A2 = 000000 (RAM Data)

DOC 1, DSKP ; Send RAM Address  
DOB 2, DSKP ; Send RAM Data  
DOAP 0, DSKP ; Send NOP Command and IOPULSE

### 4.3.3 ALTERNATE MODES

A command that will change the context of the data received from a DIA, DIB or DIC. A command other than Alternate Mode or an IORESET will clear Alternate Mode.

#### 4.3.3.1 ALTERNATE MODE ONE

It changes the context of DIA to read the current memory address. The ending address after a Read/Write transfer will point to the last address plus one.

#### 4.3.3.2 ALTERNATE MODE TWO

It changes the context of the DIA and DIB command. This is used to extract the syndrome (ECC remainder not equal to zero after a read command) from the controller in order to determine whether the data error within the sector read is correctable or not.

### 4.4 ERROR CORRECTION CODE (ECC)

When a write command is specified the ECC hardware divides the data field within the sector by a fixed \*generator polynomial and appends the resulting checkword to the data field.

\*Generator Polynomial

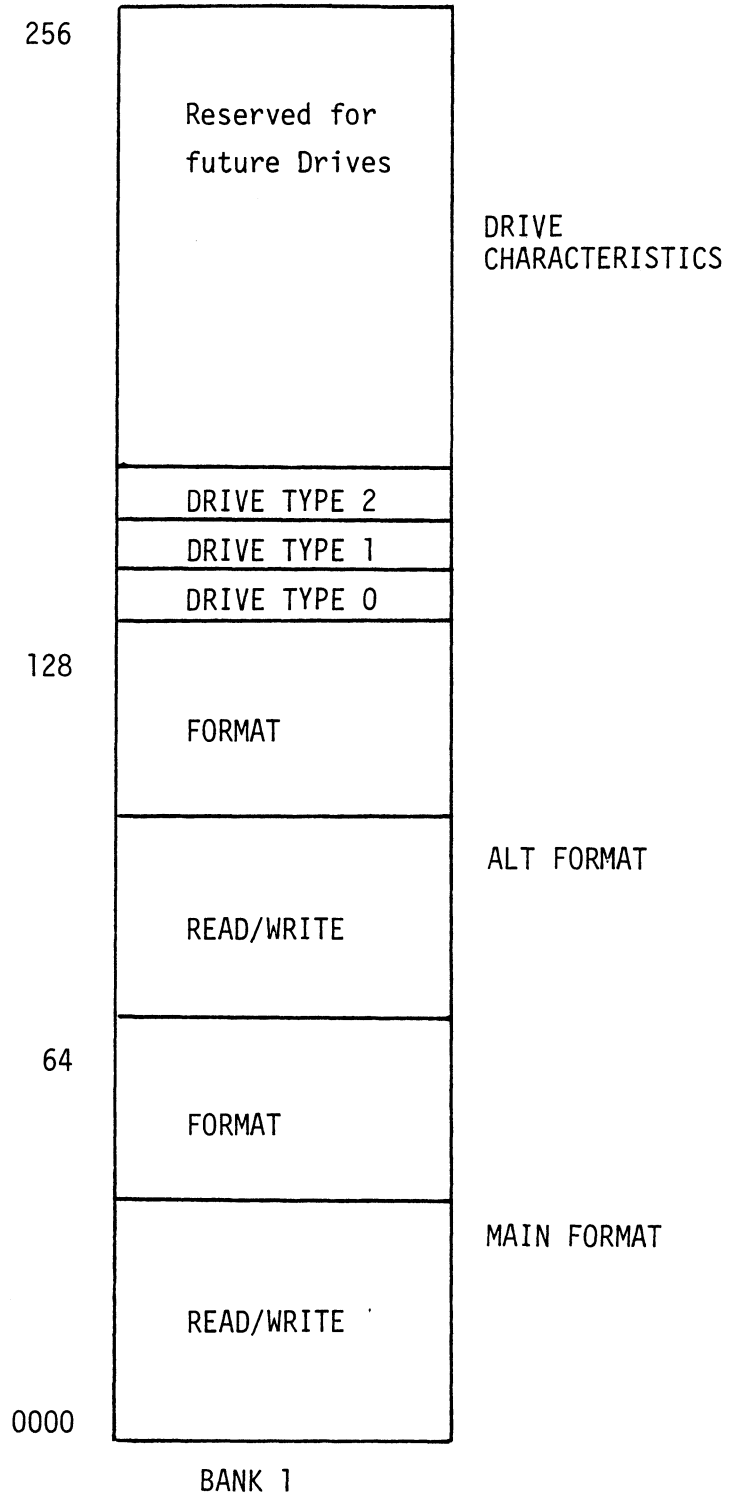
$X^{-32} + X^{-23} + X^{-21} + X^{-11} + X^{-2} + 1$

When a read command is specified the ECC hardware divides the data field and the appended checkword within the sector by a \*factored version of the same generator polynomial. If a data error occurs, the resulting remainder is non-zero, and the data transfer status (DIA) bit position 8 is set (bit 8 will not set if the controller was enabled to correct and the error is correctable). Be aware that there exists a small class of errors which are undetectable due to the cyclic properties of the generator polynomial.

**\*Factored Version**

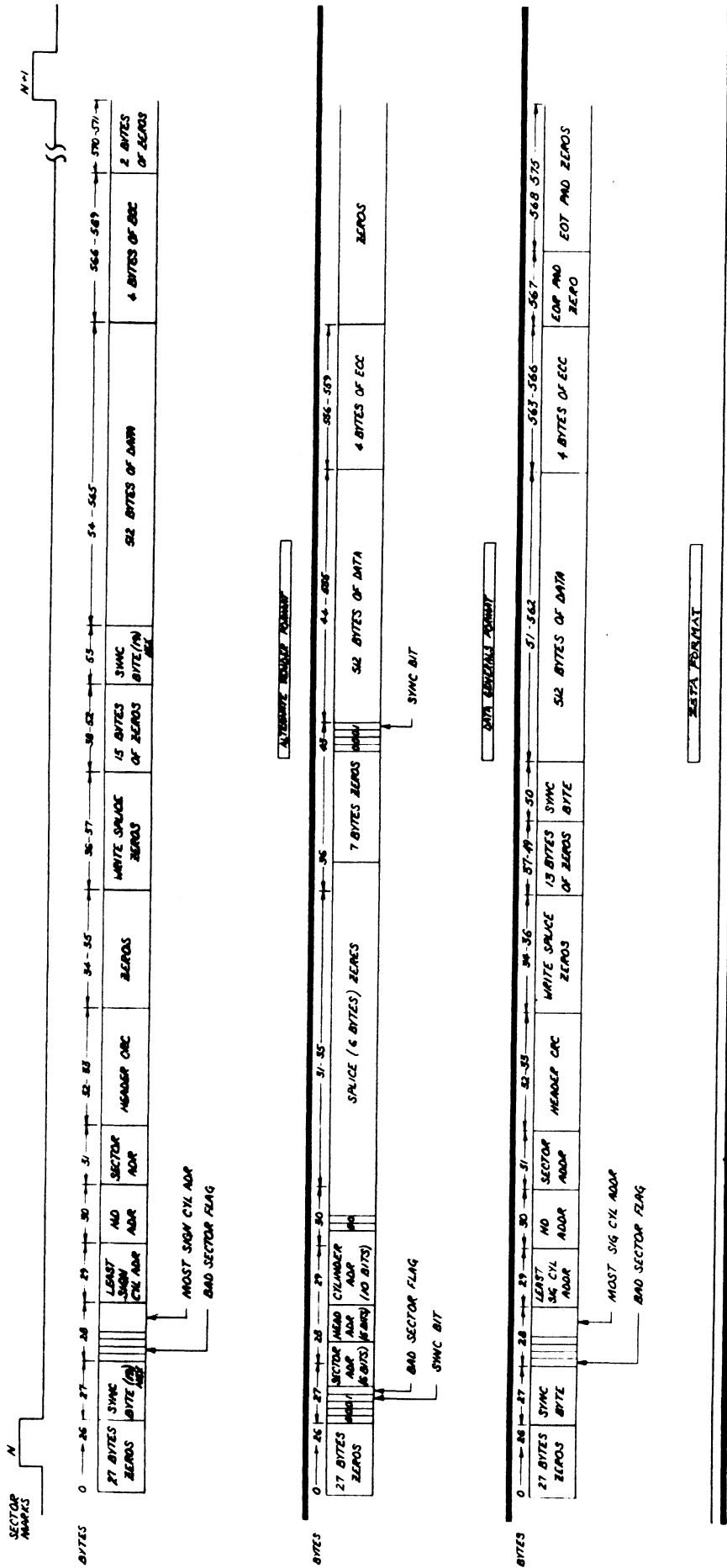
$$(X-1 + X-2 + 1) (X-21 + 1)$$

The ECC feature detects all error bursts contained within 21 or less contiguous bits in a sector and allows correction of all error bursts up to 11 contiguous bits.



FORMAT SEQUENCER EPROM MAP

Figure 5.1



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HEADER FORMATS FIGURE 5.2



## 5.0      FORMAT SEQUENCER

The 295 Disk Controller features a format sequencer which controls the disk side of the Controller. The firmware which controls this sequencer is contained in 2716 EEPROMS allowing disk format changes to take place in the EEPROMS instead of the microprocessor firmware.

The format sequencer firmware is arranged in eight banks of 256 words each and is switch selectable for the format bank desired. Each bank consists of half READ/WRITE/FORMAT CODE and the other half drive characteristics. See Figure 5.1.

### 5.1      READ/WRITE FORMATS

The Read/Write/Format section of a given bank contains the format choices (Main or Alternate).

The Alternate Format is selected only on Ports 2 and 3. Therefore, two header format types could operate simultaneously on this Controller restricted only by the port locations. See Figure 5.2 for Header Formats supported.

### 5.2      DRIVE CHARACTERISTICS

The drive characteristics section consists of 16 separate blocks of drive characteristics configurable for each port.

The following is information necessary to format size and communicate precisely with a given disk drive.

- 1) Maximum Surface, Sector and Cylinder Address
- 2) Dual Volume (CMD, Lark, etc.)
- 3) Sync Byte



## 6.0     DIAGNOSTICS AND SOFTWARE

There are three levels of diagnostics; On-board Self-test, System Diagnostics and System Reliability Programs.

Included in the DC-295 package is a master 400-284-00 tape containing these diagnostics and other ZETACO supplied software.

To load a program from the tape you should:

Mount 400-284-00 tape on drive.

Set console switches to 100022 or 100062.

Press RESET and then LOAD switches.

The 400-284-00 tape menu will be displayed:

FILE #	PROGRAM
2	Disk Diagnostic
3	Disk Formatter
4	Disk Reliability
5	ZDKINIT - Disk Initializer
6	ZDSKED - Stand-Alone Disk Editor
7	Previous "SV" and "TX" Files in Dump Format
8	ECC Programs in Dump Format: RDOSECC.SV - for RDOS AOSECC.PR - for AOS

File # (CR):

You should enter the file number of the program you wish to execute for files 2, 3, 4, 5 or 6.

To load files from file 7 or 8, use the standard CLI commands:

LOAD/R/V MT0:N (for RDOS)

X RDOS LOAD/V @MTA0:N +.SV +.PR +.TX/C (for AOS)

## 6.1 SELF-TEST

Tests all the internal functions of the Controller board once for every time power is applied to the board. If short RAM test is enabled the test takes approximately 300 MS. If long RAM test is selected (See Section 3.4.2 for switch setting) the test takes one minute.

If Self-test passed, the red LED will go out. If a failure was detected, the LED will blink a repetitious code indicating the subtest and corresponding circuit that failed.

Looping on error can be achieved by setting SW1 at H5 (See Section 3.4.2) and depressing the I/O reset switch which causes the microprocessor to loop on that particular subtest.

Looping on Self-test can be achieved by setting SW2 on H5 (See Section 3.4.2) which causes the microprocessor to continuously loop on the entire Self-test unless an error occurs. The LED will pulsate on each pass.

Reference Table 6.1 for Self-test Error Codes.

CODE	TEST	POSSIBLE FAILURE
1	REGISTER TEST	The data in register F did not compare with register Q. 2901 or 2902 may be bad.
2	RAM TEST	Data read from RAM did not compare with data written. 2114, PBUS or RAM data bus may be bad.
3	2940 ADDRESS GENERATOR TEST	Data read from 2940's did not compare with data written. 2940 may be bad.
4	CONDITION FF, BIT TEST AND 32 BIT SHIFT TEST	The state of the condition flip flops were not correct. Command Full, Busy, Done, Control Full, Overflow (2901), DCHDN (2940) may be bad. The bit testing logic may have failed. The bit shifting mechanism may have failed. (2901)
5	SEQUENCE ERROR TEST	A forced sequence error did not occur within a specified amount of time. Format sequencer may be bad. (No Clock)
6	SYNC DETECT TEST	A sync detect was not made in a specified amount of time or the terminate FF may not have set. The sync register or compare logic may be bad or the terminate FF may be bad.
7	ECC TEST	The generated ECC pattern did not compare with the expected pattern. The shift registers, ECC logic, or multiplexers may be bad.

If this LED does not blink or go out, then the 2925 clock circuitry or the 2910 might be bad.

#### SELFTEST ERROR CODES

TABLE 6.1

## 6.2 DISK DIAGNOSTIC

This diagnostic program is provided to find failures that are related to the basic operations of the Disk Controller.

Load the program from the tape provided. (See 400-284-00 tape loading in Section 6.0).

The following is a sample dialogue:

ZETACO...DISK DIAGNOSTIC REV. XX

STARTING ADDRESSES:

200-DIAGNOSTIC (INITIALIZE)  
201-DIRECT ODT ENTRY  
202-RANDOM SEEK EXERCISERS  
    SEEK EXER 1 IS A SINGLE DRIVE EXERCISER  
    SEEK EXER 2 IS A TWO DRIVE EXERCISER WITH SEEK OVERLAP  
500-DIAGNOSTIC (RESTART)

ENTER DEVICE CODE (27):

ANY DUAL VOLUME UNITS? ENTER 1

ENTER UNIT NUMBERS (0,1,2,3) TO RUN: 0,2

SET SWPAK AS PER 8.0, OR HIT (CR) TO CONT.

TESTING UNIT 0

MAX # OF SECTOR/TRACK WITH THIS CONTROLLER IS 32.

UNIT	HDS	CYLS	SEC/TRK	FORMAT
0	5	823	32	ZETACO
2	5	815	24	ZETACO

THESE ARE THE UNITS AND CHARACTERISTICS FOUND, DO YOU WANT TO LOOP ON READING THEM? ENTER 1.

See Diagnostic Text at the end of Manual for further details.

### 6.3     DISK FORMATTER

The Disk Formatter Program is a utility designed program to format and check disk packs to be used on the disk systems.

The following is a sample dialogue:

ZETACO...DISK FORMATTER REV. XX

STARTING ADDRESSES:

500-FORMATTER/CHECK PROGRAM  
501-CHECK PROGRAM ONLY  
502-ERROR LOG RECOVERY  
503-COMMAND STRING INTERPRETER

ENTER DEVICE CODE (27):

SET SWPAK AS PER SECT 8.0 OR HIT (CR) TO CONTINUE

START TIME? - MON, DAY, YR HR, MIN

# PASSES TO FORMAT COMPLETION? - 6

CONTROLLER ECC CORRECTION IS ENABLED

DO YOU WANT TO SOFTWARE DISABLE (YES/NO)? YES

UNIT	TYPE	HDS	CYLS	SEC/TRK	FORMAT
0	0	5	823	32	D.G.
2	1	5	815	24	D.G.

ENTER UNIT NUMBERS (0,1,2,3) TO RUN: 0,2

UNIT: 0

ENTER TYPE OF DISK: 0

UNIT: 2

ENTER TYPE OF DISK: 1

FORMATTING UNIT 0,2

See Formatter Text at end of Manual for further details.

## 6.4 DISK RELIABILITY

The Disk Reliability program is a maintenance program designed to exercise and test the disk system. The program will test from one to four drives.

The following is a sample dialogue:

ZETACO...DISK RELIABILITY REV. XX

STARTING ADDRESSES:

- 500-RELIABILITY TEST
- 501-RELIABILITY TEST WITH OPTIONS
- 502-DISK ADDRESS TEST
- 503-COMMAND STRING INTERPRETER
- 504-FORMAT ONLY
- 505-RUN ALL TESTS
- 506-SEEK EXERCISER
- 507-RANDOM SEEK EXERCISER
- 510-ERROR COUNT/LOG RECOVERY

ENTER DEVICE CODE (27):

STARTING ADDRESS = 505

SET SWPAK AS PER 8.0, OR HIT (CR) TO CONT.

ARE MAPS TO BE EXERCISED (YES/NO)? YES

NOVA 3 TOTAL OF 1K'S = 64

START TIME? - MON, DAY, YR HR, MIN

ANY DUAL VOLUME UNITS (YES/NO)? NO

CONTROLLER ECC CORRECTION IS ENABLED

DO YOU WANT TO SOFTWARE DISABLE (YES/NO)? NO

UNIT	TYPE	HDS	CYLS	SEC/TRK	FORMAT
0	0	5	823	32	D.G.
2	1	5	815	24	D.G.

ENTER UNIT NUMBERS (0,1,2,3) TO RUN: 0,2

UNIT: 0

ENTER TYPE OF DISK: 0

UNIT: 2

ENTER TYPE OF DISK: 1

TESTING UNIT 0,2

See Reliability Text at the end of Manual for further details.



## 6.5 ZDKINIT - RDOS DISK INITIALIZER

### Initializing a Model DC-295 Disk Controller

Before you load any RDOS system onto a Model DC-295 Disk, you must initialize the disk by running ZDKINIT. This is a Stand-Alone program which performs all the functions of Data General's DKINIT. Please refer to Data General manual on loading an RDOS system for full details on the functionality of disk initialization.

Remember that only ZDKINIT will work correctly for Model DC-295 Disks. If you are building your system from an RDOS release tape, do NOT run file 4 on the DG tape after running ZDKINIT. Data General's DKINIT cannot be run on a Model DC-295 Disk. ZDKINIT can, however, be used to initialize any DG supported disk.

### STEP 1 - LOADING

A) If loading from a 400-284-00 tape:

Perform the steps described for loading 400-284-00 tape in Section 6.0.

YOU RESPOND:

5

B) If loading from disk: (ZDKINIT.SV must have been previously loaded onto the disk.)

Mount the disk pack which contains ZDKINIT.  
Set console switches to correct device code.  
Press RESET and LOAD switches.

PROGRAM DISPLAYS:

FILENAME?

YOU RESPOND:

ZDKINIT or (DIR:ZDKINIT, if the program file is  
located in directory, DIR, other than the  
master).

STEP 2 - DISK TYPE

PROGRAM DISPLAYS:

DISK INITIALIZER - REV. NN.NN/with ZETACO Disk  
Support-REV. 1  
DISK DRIVE MODEL NUMBER?

YOU RESPOND:

6XXX

A) If the disk type is not valid-

PROGRAM DISPLAYS:

ILLEGAL DISK TYPE

Step 2 will be repeated until your response is acceptable.

B) If the disk type is valid -

PROGRAM DISPLAYS:

6XXX (ZETA Emulation) Drive Type

STEP 3 - DISK UNIT

PROGRAM DISPLAYS:

DISK UNIT?

YOU RESPOND:

DZx, where x indicates drive number: 0, 1, ..., 7

A) If the disk unit is not valid -

PROGRAM DISPLAYS:

ILLEGAL DISK UNIT DECLARATION

Step 3 will be repeated until your response is acceptable.

B) If the disk unit is valid -

PROGRAM DISPLAYS:

# HEADS	# SEC/TRK	# CYLINDERS	MGB/BLK
99	99	999	Megabytes if disk >4000 blks. Blocks if disk <4000 blks.

STEP 4 - ECC CORRECTION

ZDKINIT will allow you to disable/enable ECC correction on the Controller, if it is currently enabled/disabled via software. If ECC correction is disabled in the hardware, this cannot be changed.

For most situations it is recommended that you software disable ECC correction while running ZDKINIT. This will allow the initializer to flag those bad blocks which are potential problems even though they might be correctable at the time of running ZDKINIT. However, it is also possible to run with ECC correction enabled in cases where there is a need for using marginal media.

The three possible dialogues are:

A) PROGRAM DISPLAYS:

CONTROLLER ECC CORRECTION IS HARDWARE DISABLED.

YOU RESPOND:

NONE

B) PROGRAM DISPLAYS:

CONTROLLER ECC CORRECTION IS ENABLED.

DO YOU WANT TO SOFTWARE DISABLE? (YES/NO)

YOU RESPOND:

YES        To disable ECC correction while running  
            ZDKINIT

NO         To leave ECC correction enabled while  
            running ZDKINIT

C) PROGRAM DISPLAYS:

ECC CORRECTION IS SOFTWARE DISABLE.

DO YOU WANT TO ENABLE? (YES/NO)

YOU RESPOND:

YES        To enable ECC correction while running  
            ZDKINIT

NO         To leave ECC correction disabled while  
            running ZDKINIT

#### STEP 5 - COMMANDS AND SUBSEQUENT OUTPUT

The commands which can be selected are identical to those of DKINIT.

From this point on ZDKINIT will perform exactly as DKINIT.

## 6.6 ZDSKED - RDOS STAND-ALONE DISK EDITOR

ZDSKED provides the same functions for the DC-295 Disk as Data General's DSKED does for standard DG disks.

It can also be used for any DG supported disk. Please refer to the Data General Stand-alone Disk Editor Manual for a complete description of the commands.

We will describe the steps necessary to run ZDSKED.

### STEP 1 - LOADING

A) If loading from a 400-284-00 Tape:

Perform the steps described for loading 400-284-00 tape in Section 6.0.

YOU RESPOND:

5

B) If loading from disk: (ZDSKED.SV must have been previously loaded onto the disk).

Mount the disk pack which contains ZDSKED.

Set console switches to correct device code.

Press RESET and LOAD switches.

PROGRAM DISPLAYS:

FILENAME?

YOU RESPOND:

ZDSKED or (DIR:ZDSKED, if the program file is located in directory, DIR, other than the master).

STEP 2 - DISK TYPE

PROGRAM DISPLAYS:

DISK EDIT - REV NN.NN WITH ZETACO DISK SUPPORT - REV. 1  
DISK DRIVE MODEL NUMBER?

YOU RESPOND:

6XXX

A) If the disk type is not valid -

PROGRAM DISPLAYS:

ILLEGAL DISK TYPE

Step 2 will be repeated until your response is acceptable.

B) If the disk type is valid -

PROGRAM DISPLAYS:

6XXX (ZETA Emulation) Drive Type

STEP 3 - DISK UNIT

PROGRAM DISPLAYS:

DISK UNIT?

YOU RESPOND:

DZx, where x indicates drive number: 0, 1, ....., 7

A) If the disk unit is not valid -

PROGRAM DISPLAYS:

ILLEGAL DISK UNIT DECLARATION

Step 3 will be repeated until your response is acceptable.

B) If the disk unit is valid -

PROGRAM DISPLAYS:

# HEADS	# SEC/TRK	# CYLINDERS	MGB/BLK
99	99	999	Megabytes if disk >4000 blks. Blocks if disk <4000 blks.

#### STEP 4 - ECC CORRECTION

ZDSKED will allow you to disable/enable ECC correction on the Controller, if it is currently enabled/disabled via software. If ECC correction is disabled in the hardware, this cannot be changed.

The three possible dialogues are:

A) PROGRAM DISPLAYS:

CONTROLLER EC CORRECTION IS HARDWARE DISABLED

YOU RESPOND:

NONE

B) PROGRAM DISPLAYS:

CONTROLLER ECC CORRECTION IS ENABLED

DO YOU WANT TO SOFTWARE DISABLE? (YES/NO)

YOU RESPOND:

YES To disable ECC correction while running  
ZDSKED

NO To leave ECC correction enabled while  
running ZDSKED

C) PROGRAM DISPLAYS:

ECC CORRECTION IS SOFTWARE DISABLED

DO YOU WANT TO ENABLED? (YES/NO)

YOU RESPOND:

YES To enable ECC correction while running  
ZDSKED

NO To leave ECC correction disabled while  
running ZDSKED

#### STEP 5 - COMMANDS AND SUBSEQUENT OUTPUT

The commands which can be selected are identical to those of DSKED. From this point on ZDSKED will perform exactly as DSKED.

## 6.7 ECC - ECC ERROR CORRECTIONS COUNTER FUNCTIONS

The Model DC-295 Controller maintains a counter of ECC corrections for each drive connected to the board(s). These are the corrections performed by the firmware and are therefore invisible to the system except through these counters. The counters are automatically cleared by the reset switch on the front panel or if the Controller is powered down.

The ZETACO supplied ECC program (RDOSECC.SV for RDOS and AOSECC.PR for AOS) allows you to monitor the media by displaying or modifying the counters. Some installations may decide to reset the counters to zero on some regular basis: daily, weekly, monthly, etc.

### STEP 1 - EXECUTING THE PROGRAM UNDER CLI

A) RDOS Version

ENTER: RDOSECC

B) AOS Version

ENTER: X AOSECC



STEP 2 - MAIN MENU

ZETACO - ECC FUNCTIONS

1 - DISPLAY CONTROLLER ECC CORRECTIONS

2 - RESET CONTROLLER ECC CORRECTIONS

3 - STOP

NOTE - SELECT ONLY THOSE DRIVES WITH ZETACO CONTROLLER BOARDS.

RESULTS ARE UNPREDICTABLE ON OTHER BOARDS!

ENTER SELECTION

YOU RESPOND:

- 1) To display the ECC corrections counter(s)
- 2) To modify the ECC corrections counter(s)
- 3) To terminate the program and return to the CLI

STEP 3 - ENTERING THE UNIT

If you selected 1 or 2,

PROGRAM DISPLAYS:

ENTER UNIT:

YOU RESPOND:

DZn (n = 0, 1, ..., 7) for RDOS  
DPFN (n = 0, 1, 2, 3, 10, 11, 12, 13) for AOS  
Carriage return or new line to return to Main Menu.

The program will display the (decimal) value of the corrections counter for the drive selected. This step will be repeated until the response to ENTER UNIT is carriage return or new line.

#### STEP 4 - MODIFYING THE COUNTER

If your response to the Main Menu was 2 - there will be another message after Step 3:

ENTER NEW VALUE:

You respond with the (decimal) value to which you want the counter set. The number must be between 0 and 65,535. This step will be repeated until you enter a carriage return or new line which will return you to Step 3.

## APPENDIX A

### DIAGNOSTIC SUPPORT PACKAGE GENERAL INFORMATION

#### BOOTSTRAP PROCEDURES LOADING DSP FROM TAPE

- 1) Load desired DSP tape and put Drive On-line.
- 2) Perform the following steps when the system has the program load option. (If system does not have program load option consult processor manual.)
  - A) Put 100022 or 100062 on console data switches 0 - 15.
  - B) Program load.
    - a) Press program load switch if front panel has switches.
    - b) DG virtual console, enter 100022L or 100062L (if 100062 first enter 100062 in 11A).
    - c) Point 4 virtual console, set switches on CPU board, enter P22 or P62.
- 3) Enter tape file number, followed by a carriage return of desired test.
- 4) If program is not self starting perform the following steps:
  - A) Front Panel Switches.
    - a) Put starting address on console data switches (0-15).
    - b) Press examine memory.
    - c) Put switch settings on console data switches (0-15).
    - d) Press continue.
  - B) Virtual Console.

DG

    - a) Enter switch settings in 11A through keyboard.
    - b) Enter starting address (XXXXR) through keyboard.
    - c) To change switch settings, enter break, change 11A through keyboard, and enter PC address when break occurred. (XXXXR)
    - d) To continue on error halt, enter PC address (XXXXR).

POINT 4

    - a) Set switches on CPU board.
    - b) Enter starting address (JXXXXX).
    - c) To continue on error halt, enter PC address (JXXXXX).

## LOADING DSP FROM TAPE TO DISK

1. The last file on the DSP tape (reference menu for number) is a dump format copy of the previous files. This allows a user to load (use RDOS load command) the files onto a disk.
2. The files can now be booted from disk (enter file name in response to filename? or pathname?).





**Please give us your comments.**

Please use this form to send us your comments regarding this Technical Manual. Your input is greatly appreciated! Problems will be promptly addressed and action taken as necessary. If you wish a written reply, please furnish your name and mailing address. Thank you.

Date\_\_\_\_\_

Name\_\_\_\_\_Title\_\_\_\_\_

Firm\_\_\_\_\_

Address\_\_\_\_\_

City/State/Zip\_\_\_\_\_

TECHNICAL MANUAL TITLE\_\_\_\_\_

DOCUMENT NUMBER\_\_\_\_\_REVISION\_\_\_\_\_

ERRORS IN MANUAL:

SUGGESTIONS FOR IMPROVING EITHER THE MANUAL OR THE PRODUCT:

\*\*\*\*\*

DESCRIPTION: ZETACO DISK CONTROLLER DIAGNOSTIC

Product of ZETACO, 1986

\*\*\*\*\*

TITLE DISKD  
.DUSR X=1  
.NOMAC X

1.0 PROGRAM NAME: DISKD.SR

2.0 REVISION HISTORY:

REV.	DATE	
00	02/17/83	
01	09/07/83	; ANOTHER RDY UNIT WARNING, 1 HD ; ERR C22, AOS BOOTSTRAP(400'S), ; NO OFFSET TESTS FOR CMD'S
02	03/28/84	; 295C, 296 AND BMX TESTS ; DEVICE CODE CHANGE ROUTINE
03	06/12/84	; ZDF1 CHANGES, A5 TESTS 17-76
04	08/21/85	; DISABLE VIRTUAL, WEL-RECAL, ; DISK SIM PARMS
05	11/20/86	; 297, 6214, HELP, DMA PTR, IORST

3.0 MACHINE REQUIREMENTS:

NOVA/ECLIPSE/MV FAMILY CENTRAL PROCESSOR  
MINIMUM of 16K READ/WRITE MEMORY  
ZETACO DISK CONTROLLER (ZEBRA TYPE)  
0-3 DISK DRIVES  
TELETYPE or CRT and CONTROL

4.0 TEST REQUIREMENTS: N/A

5.0 SUMMARY:

The ZETACO DISK CONTROLLER DIAGNOSTIC PROGRAM  
Is a HARDWARE DIAGNOSTIC for the ZETACO DISK  
CONTROLLERS and DRIVES. The Device Code may be 20-76  
OCTAL with the Default being 27.

6.0 RESTRICTIONS:

This Program has no Restrictions as to Single or  
Dual Processor Hardware Configuration. However, the  
Diagnostic may be run on ONLY ONE CPU at a time and  
must be the only Program being run within the Disk  
System.

; 7.0 PROGRAM DESCRIPTION/THEORY OF OPERATION:

; 7.1 "A" TESTS CHECK:

- ; - BUSY, DONE, I/O BUS SELECT LOGIC
- ; - DISK SELECT LOGIC, CONTROLLER RAM

; 7.2 "B" TESTS CHECK:

- ; - START, BUSY, CLEAR LOGIC
- ; - RECALIBRATE, ATTN, INTERRUPT LOGIC
- ; - INTERRUPT DISABLE, INTA LOGIC
- ; - That SEEKS to CYL'S 0, 1/2 CYL MAX, and CYL MAX
- ; can at least be EXECUTED and SET DRIVE BUSY.
- ; - READY/SELECT LOGIC

; 7.3 "C" TESTS CHECK:

- ; - That the CA REGISTER INCREMENTS properly
- ; VIA DCH or BMC REQUESTS
- ; - That a WRITE can be EXECUTED
- ; - SELD, CLEAR LOGIC
- ; - That SEEK/WRITE Operations can be EXECUTED
- ; - WRITES to Different HDS, SECTORS
- ; - MULTI-SECTOR WRITES
- ; - The INCREMENT HEAD LOGIC
- ; - ILLEGAL SECTOR, SURFACE, CYLINDER Conditions

; 7.4 "E" TESTS CHECK:

- ; - That a READ may be EXECUTED
- ; - 8 SECTOR WRITE/READ OPERATIONS (9 Different
- ; Data Patterns) at CYL'S 0, 1/2 CYL MAX and CYL MAX
- ; with Full Core Compare
- ; - Data VERIFY Function (Normal and with Forced Errors)
- ; - OFFSET MODES
- ; - ILLEGAL COMMAND TRAPS
- ; - WRITE CYL# to HEAD 0, SECTOR 0 of All Cylinders
- ; - WRITE HEAD # to SECTOR 0 of All Heads on CYL 0
- ; - WRITE SECTOR # to All Sectors of Head 0, CYL 0
- ; - Each of the above Operations is followed by
- ; a Corresponding READ/CHECK Operation to Verify
- ; Disk Addressing Logic.

; 7.5 "F" TESTS CHECK:

; The Format Logic on CYL 0, HEAD 0, SECTOR 0,  
; A SET BAD SECTOR FLAG given and TESTED.  
; The FORMAT is set to Normal after Completion  
; of these Tests.

; 7.6 "S" TESTS ARE SEEK EXERCISERS

- ; - Performs RANDOM SEEKING. Each SEEK is Followed
- ; by a Read to Head 0, Sector 0
- ; - Performs RANDOM OVERLAPPED SEEKING to TWO DRIVES.
- ; Each SEEK is Followed by a Read to Head 0, Sector 0.
- ; U1 is the the Primary Unit under Test and U2
- ; is the next Drive found in a 1,2,3,0 ETC. Search.
- ; If only 1 Drive, Test is Bypassed. Test is only run
- ; after a Pass is Achieved on All Drives.



; 8.0 OPERATING MODES/SWITCH SETTINGS:

;8.1 SWITCH SETTINGS

; Location "SWREG" is used to select the program options. This  
; Location will be set according to the answers supplied by  
; the Operator. The Options can be changed or verified by  
; using one of the commands given in Sec. 8.3.

;8.2 SWITCH OPTIONS

; Different bits and their interpretation at location  
; "SWREG" is as follows:

BIT	OCTAL VALUE	BINARY VALUE	INTERPRETATION
1	40000 000000	0 1	LOOP on ERROR SKIP LOOPING on ERROR
2	20000 000000	0 1	PRINT to CONSOLE ABORT PRINT OUT to CONSOLE
3	10000 000000	0 1	DO NOT PRINT % FAILURE PRINT % FAILURE
5	02000 000000	0 1	DO NOT PRINT on the LINE PRINTER PRINT on the BYTE I/O LINE PRINTER(DC17)
6	01000 000000	0 1	DO NOT HALT on ERROR HALT on ERROR
7	00400 000000	0 1	N/A DISABLE FORMATTING HD 0, CYL 0, SEC 0
8	00200 000000	0 1	N/A RECALIBRATE during SCOPE LOOP
9	00100 000000	0 1	N/A 1 SECOND DELAY during SCOPE LOOP
10(A)	00040 000000	0 1	N/A PRINT TEST #'S and FIRMWARE REVISIONS
11(B)	00020 000000	0 1	N/A PROGRAM will EXIT to ODT when not in TESTS F1-F3 SWT is Set to 0 upon EXIT
12(C)	00010 000000	0 1	SKIP LONG RAM TEST LONG CONTROLLER RAM TEST
16(G)	00000 100000	0 1	DO NOT PRINT on the DMA LINE PRINTER PRINT on the DMA LINE PRINTER(DC 17)

;8.3 SWITCH COMMANDS

; Once the Program starts executing the state of any of  
; the Bits can be changed by Hitting KEYS 1-9, A-Z. The  
; Program will Continue Running after Updating the Options.  
; Each Key will Complement the state of the Bit affilia-  
; ted with it, thus Bit 4 can be Altered by Hitting Key 4.  
; Setting of any Bit of Location "SWREG" will Set Bit 0.  
; (Default Mode is defined as all Bits of SWREG Set to 0)

```

;8.4 OTHER COMMANDS (* = CONTROL KEY)
;
;"CR" A "RETURN" can be typed to Continue the Program
; after its locked in a Switch Modification Mode
;
;*D This Command given at any time will reset "SWREG"
; to Default Mode and Restart the Program.
;
;*R This Command given at any time will Restart the
; Program. Switches are left with the values they
; had before the Command was issued.
;
;*O This Command given at any time will cause the
; Program Control to go to ODT.
;
;M This Command given at any time will print the
; Current Operating Modes.
;
;O This Command given at any time will lock the
; Program into Switch Modification Mode where
; more than 1 Bit can be changed.
;
;
; 9.0 OPERATING PROCEEDURE/OPERATOR INPUT:
;
; 9.1 Load the Program
;
; 9.2 STARTING ADDRESSES
; 200-To IDENTIFY DISK TYPE (INITIALIZE)
; PROGRAM then PROCEEDS to 500.
; 201-ODT DIRECT ENTRY ONLY
; 202-RANDOM SEEK EXERCISERS. (1 PASS of DIAG FIRST)
; SEEK EXER 1 is a SINGLE DRIVE EXERCISER
; SEEK EXER 2 is TWO DRIVE EXERCISER with SEEK OVERLAP
; 500-DIAGNOSTIC (RESTART)
;
; 9.3 The Program Prints "PASS" following each
; Complete Pass through the Tests. Random
; Seek Exerciser performs 1000 Seeks
; per "PASS" Message.
;
; 9.4 Device Code of Controller is Requested (27 is Default)
;
; 9.5 Unit Numbers to be Tested are Requested to which the
; Operator Enters the Unit Numbers to be Tested, Separating
; the Individual #'s by a <,> or <Space>.
;
; 9.6 Operator is Requested to Enter 1, if Unit Characteristics
; Displayed are INCORRECT, and Wants to LOOP on Reading them.

```

```

; 10. PROGRAM OUTPUT/ERROR DESCRIPTION:
;   When an ERROR is Detected the Program Prints the ERROR
;   PC, AC'S 0,1,and 2 at the point of ERROR, the Program then
;   goes into a Scope Loop between the Entries to .SETUP and
;   .LOOP allowing the Operator to Set SWPAK. In General the
;   ERROR PC will point to a Call ERROR.

;   The Printout will be of one of the following Formats:

;   A. STANDALONE CONTROLLER TEST FAILURES-

;   B. STATUS ERRORS

;   MODE     UNIT     #       DATA
;   CYL      #       HEAD     #       SECTOR  #
;   AC1(STATUS) SHOULD =AC0
;   DESCRIPTIONS of FAILING STATUS BITS

;   C. MEMORY/DISK ADDRESS ERROR

;   MODE     UNIT     #       DATA
;   CYL      #       HEAD     #       SECTOR  #
;   ENDING MEMORY/DISK ADDRESS ERROR
;   AC1(MA/DA) SHOULD =AC0

;   C. INTERRUPT TIMEOUT

;   MODE     UNIT     #       DATA
;   CYL      #       HEAD     #       SECTOR  #
;   INTERRUPT TIMEOUT

;   Additional Test Significance can be found in the Program
;   Listing, although it is hoped that a need for the Listing
;   will be Minimal. SWPACK(SWREG) will provide all Control
;   over Test Loop Options and Printouts.

;   Data Errors will result in the 1st 3 Good/Bad pairs and
;   their Addresses being Printed along with the Total Count.
;   If an ECC Error is Detected, the Call EHECC will
;   Acknowledge the Fact and Return to the Main Test for
;   the Data Compare. Printouts result on the 1st Error Pass
;   only. As the Check Routine Checks the entire Read Buffer,
;   any Error accompanied by an ECC Error, terminating the
;   Read, may cause all Data in succeeding Sectors to appear Bad.

;   Tests that perform a Recalibrate have a 2 SEC. Delay built
;   into the Scope Loop. Set SWPAK 9 = 1 to introduce an
;   additional 1 Second Delay during the Scope Loop.

;   In General each successive Test Assumes all Previous Tests
;   work. Bypassing Errors can result in confusing situations
;   in the setup of more Complex Tests.

```

; 11. DEBUG HELP:

; OCTAL DEBUGGER (ODT)

; This Diagnostic is equipped with a built in ODT which can be  
; accessed by hitting CONTROL O at any time during the execution  
; of the Program (after Setting the Parameters). On entering ODT  
; the Address of the Location having the next instruction to be  
; executed will be typed-out.

; The following Conventions are used by the ODT:

; ? Pressing any illegal key causes the ODT to respond  
; with a "?".

; @ ODT is ready and at your service.

; An ODT Command has the following Format:

[ARGUMENT][COMMAND]

; An Argument may be one of the following:

; "EXP" An OCTAL Expression consisting of OCTAL Numbers  
; separated by Plus (+) or Minus (-) signs. Leading  
; Zeros need not be typed.

; "ADR" An Address is the same as an Expression except  
; that BIT 0 is neglected.

; A Command is a single teletype character

; The Locations that can be EXAMINED and MODIFIED by the user  
; are called CELLS. These CELLS are of two Types: Internal CPU  
; Cells and Memory Locations. The Command to OPEN one of the  
; Internal Registers is of the form "nA" where n is any OCTAL  
; Expression between 0 and 7.

; 0-3 For ACCUMULATORS 0-3

; 4 For PC of the next instruction to be Executed in the  
; event of a "P" Command.

; 5 CPU and TIO Status

BIT INTERPRETATION

15 Status of TIO DONE FLAG

14 Status of INTERRUPTS (ION FLAG)

13 Status of CARRY BIT

; 6 Address of the Location having the BREAK POINT (If any)

; 7 Instruction at the BREAK POINT Location

; Other Commands to OPEN Cells are:

; "ADR"/ Open the Cell and Print its contents

; ./ Open the Cell currently pointed to by the Pointer and  
; Print its contents.

; +"ADR"/ Add "ADR" to the Pointer, Open the Cell and Print its  
; contents.

; -"ADR"/ Subtract "ADR" from the Pointer, Open the Cell and  
; Print its contents.

; "CR" The Return Key is used to Close the Open Cell with or  
; without Modification.

; "LF" Line Feed is used to Close the Open Cell with or without  
; Modification and to Open the succeeding Cell.

; CTRL Close the Open Cell with or without Modification and  
; Open the preceeding Cell.

; / Close the Open Cell without Modification, and Open the  
; Cell pointed to by its contents.

; +"ADR"/ Close the Open Cell without Modification, and Open the  
; Cell pointed to by its contents + "ADDR".

; -"ADR"/ Close the Open Cell without Modification, and Open the  
; Cell pointed to by its contents - "ADR".

; Modification of a Cell:

; Once a Cell has been opened its contents can be Modified by  
; typing the New Value the Cell is to contain in the form of  
; an OCTAL Expression followed by "CR" or "LF". If a + or - is  
; typed as the first character of the Expression then the Value  
; of the Expression is Added to or Subtracted from the Old  
; contents of the Cell. The Address itself or an Expression  
; relative to the Address can be Deposited by typing a "." or  
; :,+/-OCTAL Expression". A Rubout Command given right after  
; opening a Cell allows the Modification of its contents as if  
; they were typed in just before the Command was issued.

; Other ODT Commands:

; RUBOUT This Key is used to Delete ERRONEOUSLY typed digits.  
; Each time the Key is pressed the right most digit is  
; Deleted and Echoed on the Terminal. If the Rubout  
; Key is pressed right after opening a Cell then it  
; Deletes the right most digit of the Cells contents.  
; This allows the Modification of the Cell as if its  
; contents were typed in just before the Key was pressed.  
; "ADR"B Insert a BREAK POINT at Location "ADR".  
; Only one Break Point can be inserted and any entry to  
; ODT after Executing a Break Point will cause it to be  
; Deleted.  
; D Delete the Break Point if any.  
; P Restart the Execution of the program at CURRENT Location  
; "ADR"R Start Executing the program at "ADR" after an IORST.  
; K Kill the String typed so far. The ODT responds with a  
; "?" and the Open Cell is closed without Modification.  
; = Print the OCTAL Value of the INPUT only.  
; This will Close any Open Cells without Modification and  
; will not Open a Cell

; NOTE: In Programs which RELOCATE THEMSELVES the  
; user should place Break Points ONLY in the  
; ORIGINAL PROGRAM AREA. If a Break Point is  
; placed outside this area the results will  
; be unpredictable.

;  
; 12. SPECIAL NOTES/SPECIAL FEATURES:

; 12.1 If the Disk Pack has BAD SECTOR FLAGS Set on Cylinder  
; 0, or on the First 8 Sectors of Head 0 of any Cylinder,  
; Error Printouts will result when the Flags are Encountered.

; 12.2 Tests F1-F3 alter the Format on CYL 0,HD 0,SEC 0 for  
; purposes of Checking the FORMAT Logic and BAD SECTOR Logic.  
; SWPAK7 should be Set to 1 in order to stop Program from  
; executing the Format.

; 12.3 Some Scope Loops will require a Recalibrate to  
; Initialize the Disk Drive following a failure. Set  
; SWPAK 8 = 1 to Introduce the Recalibrate to the Unit  
; under Test.

; 12.4 DISK PACKS

; Only use Disk Packs Formatted by the DISKF Pack Formatter  
; Program. The Diagnostic Program will Write over most of  
; the Disk Surface.

; 13. RUN TIME:

; The Run Time for a PASS is approximately: 3 MIN.

\*\*\*\*\*

DESCRIPTION: ZETACO DISK CONTROLLER RELIABILITY PROGRAM

Product of ZETACO, 1986

\*\*\*\*\*

```

;-----:TITLE-----DISKR-----:
;      .DUSR      X=1
;      .NOMAC     X
;1.0    PROGRAM NAME:   DISKR.SR

```

2.0 REVISION HISTORY:

```

;      REV.      DATE
;      00        02/09/83
;      01        09/07/83
;
;      02        03/28/84
;
;      03        05/30/84
;
;      04        08/21/85
;
;      05        11/20/86

```

;S120 # SKP TOGETHER, STACK AND  
;AOS BOOTSTRAP AT 400, NO VERIFY  
;W/RANDOM DATA TEST 502 SWT 10  
;ADD RELEASE COMMAND TO RC  
;FOR DUAL PORT, DAISY CHAIN  
;DISK SECTOR PULSE COUNTER  
;DEVICE CODE CHANGE ROUTINE  
;502 PAT 24 SECTOR  
;ZDF1,  
;DISABLE VIRTUAL, UP TO 2048.  
;CYLS, 40 HDS  
;MULTI DC 500 & 505, DMA PTR  
;MAJOR

3.0 MACHINE REQUIREMENTS:

```

;      NOVA/ECLIPSE/MV FAMILY CENTRAL PROCESSOR
;      16K READ/WRITE MEMORY
;      ZETACO DISK CONTROLLER (ZEBRA TYPE)
;      0-3 DISK DRIVES
;      TELETYPE or CRT and CONTROL

```

4.0 TEST REQUIREMENTS: N/A

5.0 SUMMARY:

```

;      The ZETACO DISK CONTROLLER RELIABILITY PROGRAM is a
;      MAINTENANCE PROGRAM designed to EXERCISE and TEST the
;      ZETACO SMD DISK SUB-SYSTEMS and 1-4 DISK DRIVES. The
;      DISK DRIVES may be shared between TWO Computers.
;
;      The Device Code may be 20-76 OCTAL with the Default
;      being 27.

```

```

;6.0 RESTRICTIONS:
;
; 1. The DISK DRIVES may be shared between TWO Computers in
; which case the following Programs may be running in each
; Computer:
;
; STARTING ADRESSES'S (SA) 500,501 RANDOM RELIABILITY
; SA 503 COMMAND STRING (If a RELEASE Command is Included
; in the Command String)
;
; If no Drives are to be Shared, there are no other
; Restrictions as to the running of these Programs on a
; Dual Processor System.
;
; 2. Any Combination of Drives may be Tested by this Program
; at a single time.

;7.0 PROGRAM DESCRIPTION/THEORY OF OPERATION:
;
; A. RELIABILITY TEST (SA 500)
;
; A Random Number Generator is used to select a Disk Drive,
; Cylinder, Head, Beginning Sector, and Number of consecutive
; Sectors. Random Data is then Generated, Written, and Read.
; The Sequence is repeated Indefinitely. If running Multiple
; Units, Over Lapped SEEKS are employed, If the next Random
; Unit is different from the current Unit under I/O Execution.
;
; B. RELIABILITY TEST (SA 501) with OPTIONS
;
; Same as A, Except that Operator is given Options on Data
; Patterns and may choose a Constant Cylinder, Head, Sector
; or # or Sectors. Any Letter response to CYL, HEAD ETC.
; gets Random function for that Variable. A Carriage Return
; only gets the Random function for all Variables.
;
; The Operator is also asked to respond to JITTER OPTION
; (YES/NO). If YES, a Random Delay(0-40,50MS) is inserted
; into the Background Loop to create a more asynchronous
; Disk I/O Loop.
;
; C. INCREMENTAL DISK ADDRESS TEST (SA 502)
;
; Operator is given Option on Data; Requested Data is first
; Written (SEE SWPAK10) over the entire Pack. Then the Data
; is Read from all Sectors . This insures that all Disk
; Blocks are useable and are Formatted properly. The Test
; is then repeated for all Ready Disks, and PASS is Printed.
; The sequence is repeated Indefinitely.
;
; #NOTE
; SWPAK8=1, puts Program into Read ONLY Mode ## SA'S 501,502 ONLY.
; If SA 501-Data must !NOT! be Random.
;
; All Numbers entered above must be in Octal. Any Non-Octal
; Input is treated as a letter. Any letter input for CYL, Head,
; Sector, or # of Sectors gets Random function in the Reliability
; Test with Options.

```



D. COMMAND STRING INTERPRETER (SA 503)  
As a trouble shooting aid the service engineer may type in their own TEST LOOP. After starting at 503, three ARGUMENTS must be entered in response to three program questions; "UNIT", "DATA", and "COMMAND STRING". All numbers must be entered in OCTAL.

I. UNIT: Type unit # or carriage return  
to use the previous entry

II. DATA: RAN=RANDOM  
ALO=ALL ONES  
ALZ=ALL ZEROS  
PAT=155555 PATTERN  
ROT=155555 PATTERN Rotated on  
Successive Passes.  
FLO=FLOATING ONE PATTERN  
FLZ=FLOATING ZERO PATTERN  
ADR=ALTERNATING CYLINDER and  
HEAD, SECTOR WORDS  
VAR=Existing words entered previously as  
described below

Alternatively enter a string of up to 7  
OCTAL 16 bit words to be used as DATA.  
The words entered are used repeatedly  
to make up a sector block. Type carriage  
return to use the previous entry.

III. COMMAND STRING:

OPTIONS 1. READ HEAD, SECTOR, #SECTORS  
2. WRITE SAME  
3. SEEK CYLINDER  
4. RECALIBRATE  
5. LOOP (go to beginning or LR)  
6. DELAY N (N=DELAY in MS)  
7. TRESPASS  
8. RELEASE  
9. OFF (OFFSET FORWARD)  
10. OFR (OFFSET REVERSE)  
11. LR (begin LOOP here)  
12. VERIFY (WRITE)  
13. FORMAT CYL, HD, SECTOR  
14. MEMORY ADDR, DATA(WRITE) (CONTROLLER MEMORY COMMAND)  
15. Type Carriage Return to use the  
previous COMMAND STRING.

Note that either SPACES or a COMMA  
may be used as an argument delimiter.  
Each response is terminated by  
typing carriage return. If more  
room is needed on a line, type line  
feed to space to the next line. The  
word "SAME" used with READ, or WRITE,  
will cause the previous disk address  
parameters to be used.

An R typed while a string is being executed will  
cause the program to return to command string start.  
The ESCAPE KEY will bypass UNIT and DATA prompts to  
the command string prompt.

The following example would cause UNIT

TO SEEK CYLINDER 50, then repeatedly,  
WRITE SECTORS 2 and 3 of HEAD 5, then  
READ it back and CHECK. Data is specified  
as ALTERNATE WORDS of ZEROS then ONES.

UNIT: 1  
DATA: 0,177777  
COMMAND STRING: SEEK 50 LR WRITE 5,2,2 READ SAME LOOP

The following example would WRITE 0 to  
CONTROLLER MEMORY location 1500 (OCTAL)

UNIT: 1  
DATA: N/A  
COMMAND STRING: MEMORY 101500,0  
NOTE: Upper memory bit = 1 defines a WRITE

E. QUICKIE FORMATTER (SA 504)  
Formats Pack and HALTS. There is NO Verify, NO Flags are  
Set, and NO Error Checking.

F. RUNALL (SA 505)  
Program alternates between the Programs described in 7.B  
(4 Data Patterns -PAT,RAN,FLZ,FLO) and 7.C(6 Data Patterns  
-PAT,RAN,RAN-2,ZEROES,ONES,ALT) and 7.H, and in that order.

G. SEEK EXERCISER (SA 506)  
Program provides a SEEK scan sequence converging from the  
extreme Outermost Tracks into the adjacent track in the  
center, then diverging again to the extremes.

H. RANDOM SEEK EXERCISER (SA 507)  
Program provides a Random SEEK sequence

###G,H all SEEKS in G/H are followed by a 1 Sector Read but  
with no Data Check. All SEEKS are timed with MAX,MIN, and  
AVE. times being Logged in MS. SEEK Paths for MAX,MIN Values  
are also Logged.

I. ERROR COUNT/LOG RECOVERY (SA 510)  
In the event a Program was stopped during a run, the Error  
Logs may be recovered at this Starting Address.  
\*\*\*MUST be done before any Program RESTART as Program  
Initialization Zeroes all Logs.

## ;8.0 OPERATING MODES/SWITCH SETTINGS:

### ;8.1 SWITCH SETTINGS

Location "SWREG" is used to select the program options.  
This Location will be set according to the answers  
supplied by the Operator. The Options can be changed  
or verified by using one of the commands given in Sec.  
8.3

### ;8.2 SWITCH OPTIONS

Different bits and their interpretation at location  
"SWREG" is as follows:

BIT	OCTAL	BINARY	INTERPRETATION
	VALUE	VALUE	

1	40000	0	LOOP on ERROR
	000000	1	SKIP LOOPING on ERROR
2	20000	0	PRINT to CONSOLE
	000000	1	ABORT PRINT OUT to CONSOLE
4	04000	0	PRINT PASS
	000000	1	DO NOT PRINT PASS
5	02000	0	DO NOT PRINT on the LINE PRINTER
	000000	1	PRINT on the BYTE I/O LINE PRINTER(DC17)
6	01000	0	DO NOT EXIT to ODT on ERROR
	000000	1	EXIT to ODT on ERROR
7	00400	0	NOT USED
	000000	1	
8	00200	0	N/A
	000000	1	For READ ONLY MODE (SA 501,502)
9	00100	0	N/A
	000000	1	BYPASS DATA CHECK
10(A)	00040	0	N/A
	000000	1	DO VERIFY After WRITE (SA 502 ONLY and NOT RANDOM DATA)
11(B)	00020	0	N/A
	000000	1	ENABLE BAD SECTOR PRINTOUTS
12(C)	00010	0	N/A
	000000	1	HALT on DRIVE ERROR prior to Recovery RECALIBRATE Operation
13(D)	00004	0	NO TRACE
	000000	1	TRACE PRINTOUT on ERROR
16(G)	00000	0	Do NOT PRINT on the DMA LINE PRINTER
	100000	1	PRINT on the DMA LINE PRINTER(DC17)

8.3 SWITCH COMMANDS

Once the Program starts executing the state of any of the Bits can be changed by Hitting KEYS 1-9, A-Z. The Program will Continue Running after Updating the Options. Each Key will Complement the state of the Bit affiliated with it, thus Bit 4 can be Altered by Hitting Key 4. Setting of any Bit of Location "SWREG" will Set Bit 0. (Default Mode is defined as all Bits of SWREG Set to 0)

8.4 OTHER COMMANDS (\* = CONTROL KEY)

- "CR" A "RETURN" can be typed to Continue the Program after its locked in a Switch Modification Mode
- \*D This Command given at any time will reset "SWREG" to Default Mode and Restart the Program.
- \*R This Command given at any time will Restart the Program. Switches are left with the values they had before the Command was issued.

; \*O This Command given at any time will cause the  
; Program Control to go to ODT.  
;  
; M This Command given at any time will print the  
; Current Operating Modes.  
;  
; 0 This Command given at any time will lock the  
; Program into Switch Modification Mode where  
; more than 1 Bit can be changed.  
;

;9.0 OPERATING PROCEEDURE/OPERATOR INPUT:

; A. Verify drive (s) are ready on-line  
; B. Load Program  
; C. To RUN other than TEST 505, Enter CONTROL "0"  
; at 9.2, Enter STARTING ADDRESS followed by an "R"

; STARTING ADDRESS

; 200 Read Unit Characteristics and then RUN ALL TEST (505)  
; 500 RELIABILITY TEST, ALL CYLINDERS  
; 501 RELIABILITY TEST, (OPTIONS)  
; 502 INCREMENTAL DISK ADDRESS TEST  
; 503 COMMAND STRING INTERPRETER  
; 504 QUICKIE FORMATTER  
; 505 RUN ALL  
; 506 SEEK EXERCISER (CONVERGING, DIVERGING PATTERN)  
; 507 SEEK EXERCISER (RANDOM PATTERN)  
; 510 ERROR COUNT/LOG RECOVERY  
; 511 MULTIPLE DEVICE CODE ENTRY

;9.1 Operator is requested to enter DEVICE CODE of CONTROLLER  
; (DEFAULT 27).  
;9.2 STARTING ADDRESS is Displayed and Operator is requested to  
; SET SWPAK followed by a Carriage Return (SEE 8.3).  
;9.3 Operator is requested to enter YES/NO to Exercise Maps, If  
; present and supported.  
;9.4 MONTH, DAY, YEAR (I.E. 77...), HOUR, & MINUTE (If [CR] is  
; given this routine is bypassed).  
;9.5 Operator is requested to enter YES/NO if any DUAL VOLUME  
; DRIVES (CMD'S).  
;9.6 Operator is requested to enter YES/NO to CONTROLLER CORRECTION,  
; if it is enabled.  
;9.7 Unit Numbers, Types, and their Characteristics are then  
; Displayed, (The Operator should Verify these values) Operator  
; is then requested to enter UNIT NUMBERS to be tested (0-3).  
;9.8 Operator is then requested to enter TYPE of disk ( to create a  
; User Defined enter 10)  
; A. If TYPE entered is 10, enter 0, 1, 2, or 3 to  
; RE-DEFINE a disk TYPE  
; B. # of HEADS for NEW TYPE (In DECIMAL)  
; C. # of CYLINDERS for NEW TYPE (In DECIMAL)  
; D. # of SECTORS for NEW TYPE (In DECIMAL, CANNOT be  
; DOWNSIZED)  
; E. RETURN to 9.7

; ## A [CR] only response to Unit Numbers, will leave Unit  
; information in previous state.

; ## A [CR] only response to YES/NO will DEFAULT to NO.  
;

; OPERATOR INPUT CONTROLLED PRINTOUTS ARE AS FOLLOWS:

; L = FIRST 100. BAD SECTORS, DATA, or ADDRESSES

W = SECTORS W/R, ERROR COUNTS, and on BOARD ECC and  
OFFSET CORRECTS  
\*\*NOTE\*\* Any Character typed will end Printouts at the next  
change of Data Type.

;10.0 PROGRAM OUTPUT/ERROR DESCRIPTION:

All Errors are Identified, Counted, and the Program is  
routed via base to a call to CKSW. on the basis of Switch  
Settings (SEE 8.2) The Program will go into a scope loop,  
or proceed, depending on the SWPAK Settings.

Upon loss of Ready and a Single Drive, the Program will  
print the appropriate Error Message and will not proceed  
until Ready is returned. If Multiple Drives exist, The  
Program will continue with the remaining Drives. If the  
down Drive is placed back On-line, the Program will resume  
Testing of that Drive. The above also applies to the loss  
of Write enable if the Program is in a Write Mode.

RECALIBRATE - Any unusual Status is reported immediately  
and an Error Return executed.

;10.1 SEEK - Positioner Fault Status Increments Seek Error  
Counter. Any Error Status results in Status Printout and  
Error Return. A Recalibrate will be performed by the Error  
Handler. Program will Log the first 20. Cylinders TO/FROM  
on finding Seek Errors.

;10.2 WRITE - Following "DONE" on a Write, Errors are checked in  
the sequence shown below. Error recovery procedure is  
outlined for each case. If the Error is not present the  
next Check is made.

Drive Status (DIB) is Checked 1st for both Read and Write  
before any DIA Checks are made.

1. READ/WRITE TIMEOUTS, DATA LATE, ILLEGAL SECTOR, PARITY,  
DATA VERIFY; or any DRIVE FAULTS- Increment the appropriate  
Error Count, Print the Illegal Status and do an Error Return.  
Any Drive Fault will cause a Recalibrate to be performed by  
the Error Handler.

2. ADDRESS ERROR- Repeat the Write, if Test Passes the  
second time, increment the Soft Address Error Count and do  
a Normal Return; otherwise increment the Hard Address Error  
count and do an Error Return.

If a Hard Cylinder Address Error occurs, a Read on an  
adjacent Head will be attempted to determine whether the  
Fault should be classed as a Seek Error or an Address Error.  
The First 20. Address Errors will have their Addresses Logged.

3. BAD SECTOR- Log the Disk Address (1st 100.) and do a Normal  
Return. No Printout will result unless SW11=1, although the  
I/O Operation was prematurely terminated. A "SOFT" Error will  
be Recorded if the Sector under Test Passes at Least 1 of 4  
Retrys. The Log denotes SOFT Errors by a count greater than 0,  
representing the Error Count tallied. \*\*\*SEE 10.3A.

4. ENDING MEMORY ADDRESS - Increment the Memory Address Error  
Count; Print the Error Message, Check for a Disk Address Error

and do an Error Return.

5. ENDING DISK ADDRESS - Increment the Disk Address Error Count, Print the Error Message, and do an Error Return.

10.3 READ - All Read Errors with the exception of Data related Errors are handled the same as described for the Write Operations.

DATA ERRORS - Data is REREAD 3 X (4X if ECC UNDETECTED) if Program is in Write/Read Mode and Data is Bad all 4 tries, A Hard Error Count is incremented and an Error Return is taken. If Data is Good on any of Four tries, a Soft Error Count is incremented and a Normal Return is taken.

If the Program is in a Read ONLY Mode (IE. Read Mode for any 502 Program or when 505 is running a 502 Program), the Data will be REREAD an additional 4 times in both Offset Forward and Offset Reverse Modes before the Problem is classed as a Hard Error.

Thus Total retries for a Hard ECC Detected Error in a Read ONLY Mode is 12 (13 for ECC UNDETECTED), and 4 if in a Write/Read Mode (5 if ECC UNDETECTED). \*\*\*SEE 10.3A

Any Successful REREADS while in an Offset Mode will be Printed and Logged. The Disk Addresses of all Data problems will be Printed and the First 100. will be Logged. The First Three Good/Bad word pairs and respective Addresses will be Printed.

If SWPAK9=1 (Bypass Data Check) Hard or Soft Data Errors will be determined by ECC Status.

### 10.3A ECC (ERROR CORRECTION CODE) ANALYSIS

All Read Passes including retries will have the ECC results Logged as per the following 4 Categories:

1. ECC CORRECTED -The ECC detected and successfully corrected the DATA ERROR.

2. NON-CORRECTABLE ECC -The ECC detected and CORRECTLY diagnosed the Error Pattern as UNCORRECTABLE.

3. ECC UNDETECTED -The ECC Failed to detect a Data Error. This may be a Malfunction of the ECC Logic, but it is more likely one of the following problems:

A Failure of the Drive to Write a Sector.

\*NOTE- A Check should be made in the Bad Sector Log to see whether a Write Operation may have encountered a Soft or Faulty Bad Sector indication, which would have terminated the Write.

A Failure in the Controller Data paths.

4. ECC FAILED -Two Conditions may fall into this Category.

4A. An ECC Error was detected but with no Accompanying Data Error. A Check is made to see whether the ECC Words point to an Error within the two Appended Write ECC Words. If such an Error is determined to be the case, the Error will be Logged as Correctable and no ECC Failed message will result. This type of Error should represent only a

; Sample). If a Significantly Higher Percentage of this  
; Error results, Then an ECC Problem would be Indicated.

; If the ECC does not point to the two Appended Write ECC  
; Words, then an ECC Failed message (1st Pass only) will  
; result and the Actual ECC Words Read from the Controller  
; will be printed.

; 4B. An ECC Error was detected, but the ECC either Failed  
; to Correct a Correctable Error, or tried to Correct an  
; Uncorrectable Error. These Conditions (Possibly caused  
; by Problems other than ECC) will result in a printout  
; (1st Pass only) of the Simulated Write and Simulated  
; Read ECC Words plus the Actual Read ECC Words as Read  
; from the Controller.

; The Simulated Write ECC Words are the result of a  
; Program Simulation of the ECC Logic on what the Program  
; believes to be the Write Data (A Write Error will cause  
; this Assumption to be False), and represents what the  
; Program believes should have been written as the Actual  
; two Write ECC Words on the Disk.

; The Simulated Read ECC Words are the result of another  
; Program Simulation of the ECC Logic on the Read Data  
; in Memory, and represent what the Program believes  
; should be Read from the Controller as the two ECC  
; Words. The Actual Read ECC Words are those two Words  
; as Read from the Disk Controller.

;10.4 ERRORS- Error Status is printed whenever encountered  
; as follows:

; 'MODE' UNIT: 'N'  
; CYL- 'N' HEAD 'N' SECT 'N' #SECT 'N'  
; DIA/DIB STATUS= 'N' 'DESCRIPTIVE MESSAGE'

; Where CYL, HEAD, SECT refer to the final Disk Address at  
; the point of Error; and #SECT refers to the Number of  
; Sectors already done in the Multiple Sector Transfer.

; When Data Errors are found, only THREE are printed per  
; encounter plus the Total Number of Errors.(See PARA 5)  
; If the Data Error is ECC UNDETECTED and the System is  
; Mapped, the Map, Physical 1K Address, and the DCH  
; Logical Addresses are also printed.

; When Looping is Involved (Retried or for Scoping)  
; Status is printed on the 1st Pass only.

;10.5 STATISTICS -

; Type a W during random testing to get a Report of the  
; Number of Sectors Written(and/or)Read, plus Error Counts  
; in Decimal. Also Listed is a Count for Controller  
; Corrects/Unit (on Board ECC Correction and Offset Corrects)

; Type L for First 100. Disk Addresses of Bad Sectors and  
; Data Errors; and First 20. of Address Errors and Seek  
; Errors (Seek Path). If Error Addresses are encountered  
; more than once (1st Pass), a Count of up to 32. will be  
; recorded in the Log. Also a Count of up to 15. Hard Errors  
; will be recorded. This Count will be A subset of the the  
; first Count.

; The Address Information will be in OCTAL while the Counts  
; will be DECIMAL.

; Type S for Seek Timing Statistics if running either Seek  
; Exerciser.



;11.0 DEBUG HELP:

;OCTAL DEBUGGER (ODT)

; This Reliability is equipped with a built in ODT which can be  
; accessed by hitting CONTROL O at any time during the execution  
; of the Program (after Setting the Parameters). On entering ODT  
; the Address of the Location having the next instruction to be  
; executed will be typed-out.

; The following Conventions are used by the ODT:

; ? Pressing any illegal key causes the ODT to respond  
; with a "?".  
; @ ODT is ready and at your service.

; An ODT Command has the following Format:

; [ARGUMENT][COMMAND]

; An Argument may be one of the following:

; "EXP" An OCTAL Expression consisting of OCTAL Numbers  
; separated by Plus (+) or Minus (-) signs. Leading  
; Zeros need not be typed.

; "ADR" An Address is the same as an Expression except  
; that Bit 0 is neglected.

; A Command is a single teletype character

; The Locations that can be EXAMINED and MODIFIED by the user  
; are called CELLS. These CELLS are of two Types: Internal CPU  
; Cells and Memory Locations. The Command to OPEN one of the  
; Internal Registers is of the form "nA" where n is any OCTAL  
; Expression between 0 and 7.

; 0-3 For ACCUMULATORS 0-3

; 4 For PC of the next instruction to be Executed in the  
; event of a "P" Command.

; 5 CPU and TIO Status

; BIT INTERPRETATION

; 15 Status of TIO DONE FLAG

; 14 Status of INTERRUPTS (ION FLAG)

; 13 Status of CARRY BIT

; 6 Address of the Location having the BREAK POINT (if any)

; 7 Instruction at the BREAK POINT Location

; Other Commands to OPEN Cells are:

; "ADR"/ Open the Cell and Print its contents

; ./ Open the Cell currently pointed to by the Pointer and  
; Print its contents.

; .+"ADR"/ Add "ADR" to the Pointer, Open the Cell and Print its  
; contents.

; .-"ADR"/ Subtract "ADR" from the Pointer, Open the Cell and  
; Print its contents.

; "CR" The Return Key is used to Close the Open Cell with or  
; without Modification.

; "LF" Line Feed is used to Close the Open Cell with or without  
; Modification and to Open the succeeding Cell.

; CTRL Close the Open Cell with or without Modification and  
; Open the preceding Cell.

; / Close the Open Cell without Modification, and Open the  
; Cell pointed to by its contents.

; +"ADR"/ Close the Open Cell without Modification, and Open the  
; Cell pointed to by its contents + "ADDR".

; -"ADR"/ Close the Open Cell without Modification, and Open the  
; Cell pointed to by its contents - "ADR".

; Modification of a Cell:

; Once a Cell has been opened its contents can be Modified by  
; typing the New Value the Cell is to contain in the form of  
; an OCTAL Expression followed by "CR" or "LF". If a + or - is  
; typed as the first character of the Expression then the Value  
; of the Expression is Added to or Subtracted from the Old  
; contents of the Cell. The Address itself or an Expression  
; relative to the Address can be Deposited by typing a "." or  
; ;,+/-OCTAL Expression". A Rubout Command given right after  
; opening a Cell allows the Modification of its contents as if  
; they were typed in just before the Command was issued.

; Other ODT Commands:

; RUBOUT This Key is used to Delete ERRONEOUSLY typed digits.  
; Each time the Key is pressed the right most digit is  
; Deleted and Echoed on the Terminal. If the Rubout  
; Key is pressed right after opening a Cell then it  
; Deletes the right most digit of the Cells contents.  
; This allows the Modification of the Cell as if its  
; contents were typed in just before the Key was pressed.  
; "ADR"B Insert a BREAK POINT at Location "ADR".  
; Only one Break Point can be inserted and any entry to  
; ODT after Executing a Break Point will cause it to be  
; Deleted.  
; D Delete the Break Point if any.  
; P Restart the Execution of the program at CURRENT Location  
; "ADR"R Start Executing the program at "ADR" after an IORST.  
; K Kill the String typed so far. The ODT responds with a  
; "?" and the Open Cell is closed without Modification.  
; = Print the OCTAL Value of the INPUT only.  
; This will Close any Open Cells without Modification and  
; will not Open a Cell

; NOTE: In Programs which RELOCATE THEMSELVES the  
; user should place Break Points ONLY in the  
; ORIGINAL PROGRAM AREA. If a Break Point is  
; placed outside this area the results will  
; be unpredictable.  
;

; MAPPED ODT COMMANDS

; In addition to the previously listed ODT Commands, there  
; is available a Command Set that allow Map Translations for  
; Debugging purposes.

; Map Command Format

; The Letter "M" is used to specify a Map Command and is  
; used in conjunction with the Set of Characters that form  
; the Map Command Group. A Map Command is thus formed by  
; using the Letter "M" and following it with the desired  
; Command Letter (Such as "MT", "MA", ETC.)

; Map Command Errors

; If a Map Command is entered and the Error Message "No Map"  
; appears, then either:

; A) A Map was not found

; B) The Program does not support Mapped ODT.

; Map Commands

; Note: All Map Commands must be preceded by an "M" to  
; indicate that they are Map Commands.

; "A" Enable User "A" Map Translations  
; "B" Enable User "B" Map Translations  
; "M" Enable Map Translations with the last "User"  
; "U" Disable Mapping  
; "L" Map Supervisor Last Block  
; "E" Print Single Map Entry  
; "T" Print Map Entry Table

;12.0 SPECIAL NOTES/SPECIAL FEATURES:  
;  
; 1. A CR only response to Unit Numbers, ETC will leave  
; Information in Previous State.  
;  
; 2. The Program will Account for up to a MAX. of 2\*\*31 Sectors  
; Written or Read. Special Test runs exceeding this facility  
; will require an OPERATOR'S TEST LOG to augment software  
; accounting. 2\*\*31 Sectors = Approx. 2\* 10\*\*9 Words.  
;  
; 4. SWPAK7=1, Program halts after write with Read Verification  
; allowing operator to change packs. SWPAK8=1, Puts Program into  
; Read only mode ## SA'S 501,502 Only. If SA 501-Data must INOT!  
; be Variable. Start at the above selected Address.  
;  
; 5. All Numbers entered in 7.0 must be in Octal. Any Non-Octal  
; Input is treated as a Letter. Any Letter input for CYL, HEAD,  
; SECTOR, or # of SECTORS gets Random function in the Reliability  
; Test with Options.  
;  
; 6. At times the ECC may attempt to Correct a Non-Correctable  
; Data Error and the Simulated ECC and Actual ECC will Match  
; even though an ECC Failure will have been Printed. This is  
; Due to a Failure of the ECC Polynomial itself to Distinguish  
; between two different Error Patterns. One Correctable and one  
; Uncorrectable. This is INOT! a Hardware Failure.

;13.0 PROGRAM RUNTIME:

; Program Runtimes are substantially reduced with Memories of  
; 16K or Larger. Program can use up to 24K using 2 Buffers  
; and up to 32K using 4 Buffers in the Random Reliability  
; Tests.

; Runtime is defined as Time from Start to a "PASS" Message.  
; Typical runtime for a Read only or Write only Pass of SA  
; 502 (Incremental Disk Address Test) is Approx. 3 and 1/2  
; Minutes with a Nova 800 (or Faster CPU) with at least 24K  
; of Memory, and 96 Megabyte.

\*\*\*\*\*

DESCRIPTION: ZETACO DISK CONTROLLER FORMATTER PROGRAM

Product of ZETACO, 1986

\*\*\*\*\*

TITLE DISKF
.DUSR X=1
.NOMAC X
PROGRAM NAME: DISKF.SR

REVISION HISTORY:

Table with 3 columns: REV., DATE, and description of changes. Includes entries for revisions 00 through 05, detailing dates and specific hardware/software changes like 'ADUB FOR ALT1', 'DISK PULSE COUNTER', and 'DISABLE VIRTUAL'.

MACHINE REQUIREMENTS:

NOVA/ECLIPSE/MV FAMILY CENTRAL PROCESSOR
16K READ/WRITE MEMORY
ZETACO DISK CONTROLLER (ZEBRA TYPE)
0-3 DISK DRIVES
TELETYPE or CRT and CONTROL

TEST REQUIREMENTS: N/A

SUMMARY:

The ZETACO DISK CONTROLLER FORMATTER PROGRAM is designed to FORMAT and CHECK DISK PACKS and MEDIA to be used in DISK SYSTEMS. The PROGRAM is NOT! A MAINTENANCE PROGRAM and ASSUMES the HARDWARE to be in WORKING ORDER. The PROGRAM will HALT on any NON-DATA related ERRORS. It is also recommended that ON-BOARD ECC be SOFTWARE or CONFIGURED DISABLED when FORMATTING. The Device Code may be 20-76 OCTAL with the Default being 27.

RESTRICTIONS:

This Program has no Restrictions as to Single or Dual Processor Hardware Configuration. However, the Formatter may be run on ONLY ONE CPU at a time and must be the only Program being run within the Disk System.

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;7.0 PROGRAM DESCRIPTION/THEORY OF OPERATION:

; A. FORMATTER PROGRAM (STARTING ADDRESS <SA> 500)
; The disk is first formatted after which a "FORMAT DONE"
; message is printed. Then a 055555 pattern is written to
; the entire pack and read back 2 times, A random seek
; test is performed, and "PASS" is printed. The data pattern
; is then rotated 1 bit and the WRITE/READ/READ/SEEK process
; is repeated. At the completion of the number of passes
; entered by the operator, A log is available to be printed
; and the drives are released.
;*****
;-----It is Recommended that at LEAST 3 PASSES (W/R/R/S); with
; On-Board ECC DISABLED, be allowed to insure Pack Quality.
; If time permits, longer runs will further insure
; Reliability.
;*****
;-----Any HARD DATA or ADDRESS ERRORS will result in the BAD
; SECTOR FLAG being set in that sector. Any "SOFT DATA" or
; "ADDRESS ERROR" ADDRESS encountered TWICE cause the BAD
; SECTOR FLAG to be set. Any other error will cause the
; program to print the failure and halt.

; A HARD ADDRESS ERROR is defined as such after 2 ATTEMPTS
; have been made BOTH resulting in an ADDRESS ERROR: A HARD
; DATA ERROR is defined as such after 2 or MORE of 10
; WRITE/READ RETRY'S have been unsuccessful.

; B. CHECK PROGRAM ONLY (SA 501)
; Same as SA 500 except that initial pack format operation is
; bypassed.

; C. STATISTICS
; Type L for 1ST 200. disk addresses of BAD SECTORS, DATA and
; ADDRESS ERRORS, plus a statistic table of overall errors.
; **NOTE** Any character typed while executing this log will
; end it at the next change of data type.

; D. LOG RECOVERY (SA 502)
; Use to recover log of program after it has stopped to get a
; LOG PRINTOUT.

; E. COMMAND STRING INTERPRETER (SA 503)
; As a trouble shooting aid the service engineer may type in
; their own TEST LOOP. After starting at 503, three ARGUMENTS
; must be entered in response to three program questions;
; "UNIT", "DATA", and "COMMAND STRING". All numbers must be
; entered in OCTAL.

; I. UNIT: Type unit # or carriage return
; to use the previous entry

; II. DATA: RAN=RANDOM
; ALO=ALL ONES
; ALZ=ALL ZEROS
; PAT=110110 PATTERN
; FLO=FLOATING ONE PATTERN
; FLZ=FLOATING ZERO PATTERN
; ADR=ALTERNATING CYLINDER and
; HEAD, SECTOR WORDS
; VAR=Existing words entered previously as
; described below

; Alternatively enter a string of up to 7

```

The words entered are used repeatedly  
to make up a sector block. Type carriage  
return to use the previous entry.

III. COMMAND STRING:

- OPTIONS
1. READ HEAD, SECTOR, #SECTORS
  2. WRITE SAME
  3. SEEK CYLINDER
  4. RECALIBRATE
  5. LOOP (go to beginning or LR)
  6. DELAY N (N=DELAY in MS)
  7. TRESPASS
  8. RELEASE
  9. OFF (OFFSET FORWARD)
  10. OFR (OFFSET REVERSE)
  11. LR (begin LOOP here)
  12. VERIFY (WRITE)
  13. FORMAT CYL, HD, SECTOR
  14. BAD (BAD SECTOR) CYL, HD, SECTOR
  15. MEMORY ADDR, DATA(WRITE) (CONTROLLER MEMORY COMMAND)
  16. Type Carriage Return to use the  
previous COMMAND STRING.

Note that either SPACES or a COMMA  
may be used as an argument delimiter.  
Each response is terminated by  
typing carriage return. If more  
room is needed on a line, type line  
feed to space to the next line. The  
word "SAME" used with READ, or WRITE,  
will cause the previous disk address  
parameters to be used.

An R typed while a string is being executed will  
cause the program to return to command string start.  
The ESCAPE KEY will bypass UNIT and DATA prompts to  
the command string prompt.

The following example would cause UNIT  
1 to SEEK CYLINDER 50, then repeatedly  
WRITE SECTORS 2 and 3 of HEAD 5, then  
READ it back and CHECK. Data is specified  
as ALTERNATE WORDS of ZEROS then ONES.

UNIT: 1  
DATA: 0,177777  
COMMAND STRING: SEEK 50 LR WRITE 5,2,2 READ SAME LOOP

The following example would WRITE 0 to  
CONTROLLER MEMORY location 1500 (OCTAL)

UNIT: 1  
DATA: N/A  
COMMAND STRING: MEMORY 101500,0  
NOTE: Upper memory bit = 1 defines a WRITE

;8.0 OPERATING MODES/SWITCH SETTINGS:

;8.1 SWITCH SETTINGS

; Location "SWREG" is used to select the program options.  
; This Location will be set according to the answers  
; supplied by the Operator. The Options can be changed  
; or verified by using one of the commands given in Sec.  
; 8.3

;8.2 SWITCH OPTIONS

; Different bits and their interpretation at location  
; "SWREG" is as follows:

BIT	OCTAL VALUE	BINARY VALUE	INTERPRETATION
1	40000	0	LOOP on ERROR
	000000	1	SKIP LOOPING on ERROR
2	20000	0	PRINT to CONSOLE
	000000	1	ABORT PRINT OUT to CONSOLE
5	02000	0	DO NOT PRINT on the LINE PRINTER
	000000	1	PRINT on the BYTE I/O LINE PRINTER(DC17)
11(B)	00020	0	N/A
	000000	1	ENABLE BAD SECTOR PRINTOUT
16(G)	00000	0	DO NOT PRINT on DMA LINE PRINTER
	100000	1	PRINT on DMA LINE PRINTER(DC17)

;8.3 SWITCH COMMANDS

; Once the Program starts executing the state of any of  
; the Bits can be changed by Hitting KEYS 1-9, A-Z. The  
; Program will Continue Running after Updating the Options.  
; Each Key will Complement the state of the Bit affilia-  
; ted with it, thus Bit 4 can be Altered by Hitting Key 4.  
; Setting of any Bit of Location "SWREG" will Set Bit 0.  
; (Default Mode is defined as all Bits of SWREG Set to 0)

;8.4 OTHER COMMANDS (\* = CONTROL KEY)

- ; "CR" A "RETURN" can be typed to Continue the Program  
; after its locked in a Switch Modification Mode
- ; \*D This Command given at any time will reset "SWREG"  
; to Default Mode and Restart the Program.
- ; \*R This Command given at any time will Restart the  
; Program. Switches are left with the values they  
; had before the Command was issued.
- ; \*O This Command given at any time will cause the  
; Program Control to go to ODT.
- ; M This Command given at any time will print the  
; Current Operating Modes.
- ; 0 This Command given at any time will lock the  
; Program into Switch Modification Mode where  
; more than 1 Bit can be changed.



```

;9.0 OPERATING PROCEEDURE/OPERATOR INPUT:
;
; A. Verify drive (s) are ready on-line
; B. Load Program
; C. To RUN other than TEST 500, Enter CONTROL "0"
; at 9.2, Enter STARTING ADDRESS followed by an "R"
;
; STARTING ADDRESS (SA)
; 200 Read Unit Characteristics and then Run FORMATTER (500)
; 500 FORMATTER/CHECK PROGRAM
; 501 CHECK PROGRAM ONLY
; 502 ERROR LOG RECOVERY
; 503 COMMAND STRING INTERPRETER
;
;9.1 Operator is requested to enter DEVICE CODE of CONTROLLER
; (DEFAULT 27)
;9.2 Operator is requested to SET SWPAK followed by a Carriage
; Return (SEE 8.3)
;9.3 MONTH, DAY, YEAR (I.E. 77...), HOUR, & MIN (If [CR] is
; given this routine is bypassed)
;9.4 Enter # of Passes for Test Completion (If [CR] is given
; this routine is bypassed)
;9.5 Operator is requested to enter YES/NO to CONTROLLER CORRECTION,
; If It is enabled
;9.6 Unit Numbers, Types, and their Characteristics are then
; Displayed, (The Operator should Verify these values) Operator
; Is then requested to enter UNIT NUMBERS to be tested(0-3)
;9.7 Operator is then requested to enter TYPE of disk ( to create a
; User Defined enter 10)
; A. If TYPE entered is 10, enter 0, 1, 2, or 3 to
; RE-DEFINE a disk TYPE
; B. # of HEADS for NEW TYPE (In DECIMAL)
; C. # of CYLINDERS for NEW TYPE (In DECIMAL)
; D. # of SECTORS for NEW TYPE (In DECIMAL, CANNOT be
; DOWNSIZED)
; E. Return to 9.7
;
; OPERATOR INPUT CONTROLLED PRINTOUTS ARE AS FOLLOWS:
;
; L = First 200. BAD SECTORS, DATA, or ADDRESSES

```

;10.0 PROGRAM OUTPUT/ERROR DESCRIPTION:

; 1. ERRORS- Error status is printed whenever encountered.  
; When Data Errors are found ONLY THREE are printed per  
; encounter. (see paragraph 10.3)

; 2. If Errors are encountered more than once, a count  
; will be recorded and a BAD SECTOR FLAG SET. All address  
; information will be printed in OCTAL.

; 3. ERROR REPORTING AND RECOVERY

; All Errors are identified, and the program is routed  
; via base to a call to CKSW. with the exception of  
; ADDRESS and DATA ERRORS. The program will then loop  
; for operator intervention; on the basis of SWPAK (see 8.)

; RECALIBRATE - Any unusual Status is reported immediately  
; and an Error return executed.

; SEEK - Positioner Fault Status results in Status Printout  
; and Error return.

; WRITE - Following "DONE" on a WRITE, Errors are checked  
; in the sequence shown below. Error recovery procedure  
; is outlined for each case. If the Error is not present  
; the next check is made.

; DRIVE STATUS (DIB) is checked 1st for both Read and Write  
; before any DIA checks are made.

; 4. READ/WRITE TIMEOUTS, DATA LATE, ILLEGAL SECTOR,  
; ECC(DATA OK), or any DRIVE FAULT- Print the illegal Status  
; and do an Error return.

; 5. ADDRESS ERROR- Repeat the Write, If Test passes the  
; second time, do a Normal return; Otherwise flag as Hard, Set  
; the BAD SECTOR FLAG for that Sector and do an Error return.

; If a HARD Cylinder Address Error occurs, a Read on an  
; adjacent Head will be attempted to determine whether the  
; Fault should be classed as a Seek Error or an Address  
; Error. The First 30. Hard Address Errors will have their  
; Addresses Logged.

; 6. ENDING MEMORY ADDRESS -Print the Error Message,  
; Check for a DISK ADDRESS and do an Error return.

; 7. ENDING DISK ADDRESS -Print the Error Message and  
; do an Error return.

; READ - All Read Errors with the exception of Data related  
; Errors are handled the same as described for the Write  
; operations.

; DATA ERRORS - Data is reread 9 times. If Data is BAD on  
; 2 or more of 10 tries, a HARD Error Count is incremented,  
; the BAD SECTOR FLAG is set in that Sector, and an Error  
; return is taken. If Data is good on all retries, the  
; Error is considered SOFT and a normal return is taken.

; The 1st 200. Data Errors (HARD or SOFT) are Logged.

;11.0 DEBUG HELP:

;OCTAL DEBUGGER (ODT)

; This Formatter is equipped with a built in ODT which can be  
; accessed by hitting CONTROL O at any time during the execution  
; of the Program (after Setting the Parameters). On entering ODT  
; the Address of the Location having the next instruction to be  
; executed will be typed-out.

; The following Conventions are used by the ODT:

; ? Pressing any illegal key causes the ODT to respond  
; with a "?".  
; @ ODT is ready and at your service.

; An ODT Command has the following Format:

; [ARGUMENT][COMMAND]

; An Argument may be one of the following:

; "EXP" An OCTAL Expression consisting of OCTAL Numbers  
; separated by Plus (+) or Minus (-) signs. Leading  
; Zeros need not be typed.

; "ADR" An Address is the same as an Expression except  
; that Bit 0 is neglected.

; A Command is a single teletype character

; The Locations that can be EXAMINED and MODIFIED by the user  
; are called CELLS. These CELLS are of two Types: Internal CPU  
; Cells and Memory Locations. The Command to OPEN one of the  
; Internal Registers is of the form "nA" where n is any OCTAL  
; Expression between 0 and 7.

; 0-3 For ACCUMULATORS 0-3

; 4 For PC of the next Instruction to be Executed in the  
; event of a "P" Command.

; 5 CPU and TTO Status

; BIT INTERPRETATION

; 15 Status of TTO DONE FLAG

; 14 Status of INTERRUPTS (ION FLAG)

; 13 Status of CARRY BIT

; 6 Address of the Location having the BREAK POINT (If any)

; 7 Instruction at the BREAK POINT Location

; Other Commands to OPEN Cells are:

; "ADR"/ Open the Cell and Print its contents

; ./ Open the Cell currently pointed to by the Pointer and  
; Print its contents.

; .+"ADR"/ Add "ADR" to the Pointer, Open the Cell and Print its  
; contents.

; .-"ADR"/ Subtract "ADR" from the Pointer, Open the Cell and  
; Print its contents.

; "CR" The Return Key is used to Close the Open Cell with or  
; without Modification.

; "LF" Line Feed is used to Close the Open Cell with or without  
; Modification and to Open the succeeding Cell.

; CTRL Close the Open Cell with or without Modification and  
; Open the preceding Cell.

; / Close the Open Cell without Modification, and Open the  
; Cell pointed to by its contents.

; +"ADR"/ Close the Open Cell without Modification, and Open the  
; Cell pointed to by its contents + "ADDR".

; -"ADR"/ Close the Open Cell without Modification, and Open the  
; Cell pointed to by its contents - "ADR".

## Modification of a Cell:

Once a Cell has been opened its contents can be Modified by typing the New Value the Cell is to contain in the form of an OCTAL Expression followed by "CR" or "LF". If a + or - is typed as the first character of the Expression then the Value of the Expression is Added to or Subtracted from the Old contents of the Cell. The Address itself or an Expression relative to the Address can be Deposited by typing a "." or ".,+/-OCTAL Expression". A Rubout Command given right after opening a Cell allows the Modification of its contents as if they were typed in just before the Command was issued.

## Other ODT Commands:

RUBOUT This Key is used to Delete ERRONEOUSLY typed digits. Each time the Key is pressed the right most digit is Deleted and Echoed on the Terminal. If the Rubout Key is pressed right after opening a Cell then it Deletes the right most digit of the Cells contents. This allows the Modification of the Cell as if its contents were typed in just before the Key was pressed.

"ADR"B Insert a BREAK POINT at Location "ADR". Only one Break Point can be Inserted and any entry to ODT after Executing a Break Point will cause it to be Deleted.

D Delete the Break Point if any.

P Restart the Execution of the program at CURRENT Location

"ADR"R Start Executing the program at "ADR" after an IORST.

K Kill the String typed so far. The ODT responds with a "?" and the Open Cell is closed without Modification.

= Print the OCTAL Value of the INPUT only. This will Close any Open Cells without Modification and will not Open a Cell

NOTE: In Programs which RELOCATE THEMSELVES the user should place Break Points ONLY in the ORIGINAL PROGRAM AREA. If a Break Point is placed outside this area the results will be unpredictable.

## 12.0 SPECIAL NOTES/SPECIAL FEATURES:

1. The Program is !NOT! a Maintenance Program and assumes the HARDWARE to be in working order. The Program will HALT on any NON-DATA related Errors.
2. It is recommended that at Least 3 Passes (W/R/R/S) be allowed (see below) to insure pack quality. If time permits, longer runs will further insure quality.

## 13.1 PROGRAM RUNTIME:

Program runtimes are substantially reduced with memories of 24K or larger. Runtimes are also dependant on CPU Type, Drive Size and Drive Type.

.EOT